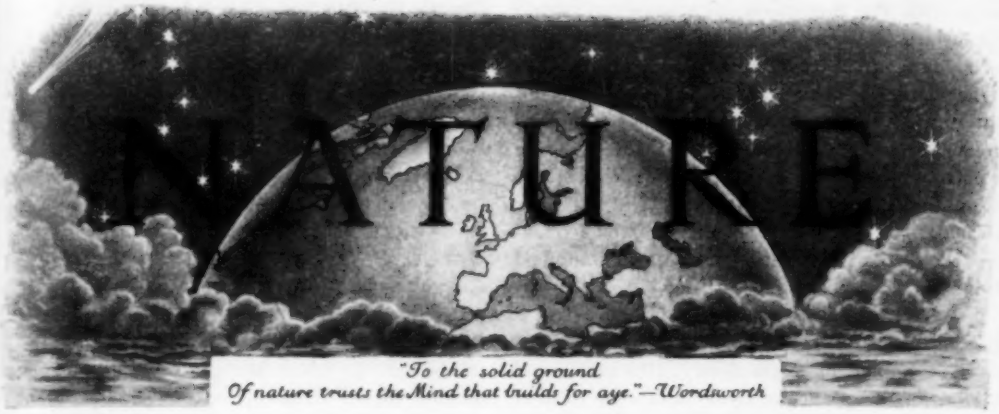

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RECONSTRUCTION IN EUROPE

EVEN in the stress and strain of the war itself, the widespread concern as to the steps to be taken to ensure that our efforts are not once again in vain is unmistakable. Only the creation of a new order founded on truth and justice can compensate for the sacrifices that have to be made, and the creation of such an order involves the co-operation both of belligerents and of neutrals. The extent to which this is evident is one of the most significant differences in the present temper of the nation in contrast with its entry into war in 1914.

While, however, it is well to bear in mind our failure to give effect to our purpose twenty years ago, there are to-day advantages which we did not then possess. The economic distress and confusion into which the life of Europe had been thrown would have endangered any political system. The design of the League of Nations demanded much larger ideas and sympathies than those which guided the treaty makers at Versailles, and surrender to the passions of the hour placed fatal obstacles in the way of the success of the new system. The mistakes and failures of the past are ours to profit by in the attempt to build again on ampler lines.

Nor should we write off the League of Nations as a complete failure. One of the most encouraging features of the last two decades has indeed been the success of its work in certain technical fields such as health, communications and transport, the welfare of women and children. That work remains and continues, as does the work of its sister body, the International Labour Organisation, and their significance will increase.

Many believe that the real weakness of the present League of Nations lies in the retention of national sovereignty. They take the view that no system of collective security can be effective unless it is part of a plan for federal government. Essentially this point of view was foreshadowed by de Madariaga in 1937 in "Theory and Practice in International Relations", and more fully in his later "The World's Design". De Madariaga insists that the nations must discard the habit of thinking of foreign affairs because there are only world affairs, and that behind any machinery, such as the League or a reformed league, for world government, there must be a sufficient body of world citizens endowed with the necessary world patriotism to give world statesmen their inspiration and guidance.

It is on the foundation of a world community that de Madariaga bases his design, the building of world institutions such as a world administration to govern mandated territories, a world bank, a world trade commission and the utilization of existing international institutions, proceeding *pari*

passu with the promotion of a sense of world citizenship. In the moral basis which he advocates, de Madariaga is arguing on similar lines to Curtius in his brilliant "Civitas Dei", and his contention that, by starting with certain practical problems, the professional interest in getting a problem properly solved may gradually come to eliminate others and substitute the disinterested, rational, exploratory type of mind for the acquisitive, the dogmatic or authoritative, will commend his approach to scientific workers.

Proposals of this type would conserve what is most worth while and possibly gain time for the development of a sufficiently advanced world opinion for acceptance of the idea of some form of federal government or union. This latter idea is outlined in detail in C. V. Streit's "Union Now". The general principle of a federal solution is reasonable in its fundamental premises, and many would be disposed to agree, at least in theory, with proposals to establish a federal government with supreme and single authority to use armed force against aggression by any nation or group outside the Federal Union, to control the use of raw materials in undeveloped territories now subordinate to its members, and to undertake the education of backward communities without racial discrimination.

For some such objectives as these much support could be found. The New Commonwealth, a body which has advocated the creation of an international police force, has been one among numerous factors disposing many to accept the limitations on national sovereignty involved in a federal or commonwealth solution. It is in the means to be taken to achieve a federal union, and the exact extent and nature of such a union that differences of opinion arise, and the practical difficulties are much greater than Mr. Streit is disposed to admit in his facile argument for union now.

Mr. Streit advocates a union of fifteen democracies of the North Atlantic, including a common citizenship, defence force, customs system, currency and postal and communication system. He urges that such a union would be so powerful in its combined resources as to assure peace to its members from the start through overwhelming preponderance and invulnerability. This number is chosen as the most practical nucleus for the organization of world government, and providing geographically, culturally, commercially, financially, politically, and historically, a cohesive nucleus. A start with the democracies is essential, because Mr. Streit proposes to base it on individual citizenship and not on the State itself as unit.

From this start Mr. Streit contemplates the growth of the Union into universal government by peaceful accession to its membership and by co-operation from the start with non-members. Despite, however, the force of Mr. Streit's contention regarding the rich heritage of the democracies in freedom and justice, we may well feel that he is unduly optimistic in arguing from American or Swiss experience as to the rate of progress in achieving such a federal union, and this view is not dispelled by his brusque treatment of the way in which the problems of a common defence force, currency, customs and postal systems are to be solved. Apart altogether from such details, there are other opinions as to the extent of federalism which should be our immediate objective, and the wisdom of scrapping entirely the experience and organization already obtained in international co-operation.

Mr. Streit's plan for union is based essentially on community of ideas and interests. An alternative to this is the Continental basis, essentially as advocated by Briand in his proposal for a European Union, though here also there is some community of ideas. Briand's plan, which lapsed largely through the refusal of Great Britain to link her fate with that of the Continent, has been revived in essence in the European Federation recommended by Count Coudenhove-Kalergi, who visualizes the world as moving towards a large group system. The Pan-American Union being organized by the United States and the Soviet Union are already examples, and a great Mongol block in the Far East is possible in the future. The peoples who care for justice, international law and the rights of men must work for the organization of Europe on good principles and under democratic influences, or that organization will be done by other hands.

A European federation might be easier to secure than the union advocated by Mr. Streit, and involve less risk in attaining it. The attitude of Great Britain will be as decisive a factor in achieving the United States of Europe as the attitude of the United States of America would be in the establishment of the Union of Mr. Streit's plan. What is most important, however, at the moment is not the choice between one plan and another, but the careful and impartial examination of the problems which have to be faced by any system of union, whatever the powers it bestows on the Federal Government.

A main argument for Mr. Streit's plan is that the peoples embraced in his Union are all with long experience of Parliamentary government, and that their economic strength and command of essential materials would be able to assure peace. Count Coudenhove-Kalergi contends that this in itself would be a provocation to the non-democratic powers and would facilitate Germany's dream of creating a federation in Central and Eastern Europe in which she would play the part Prussia played in Bismarck's German federation. His plan would offer Germany and Italy a place in the federated Europe, and while their claims to domination would be resisted, the whole of Europe and a great part of Africa would be their living space.

Unquestionably a Europe organized on a basis of close co-operation between the several States would provide peaceful and constructive opportunities for the varied elements in Germany. Co-operation between such a federation and the Pan-American Union could scarcely fail to secure the peace of the world.

A major difficulty will, of course, be the safeguards to be provided against a repetition of aggression. It is for this reason that we must think of the settlement after the present war not simply in terms of ideals or of military or political force, but as an essentially practical problem—that of utilizing to the maximum the enduring moral and constructive forces which already exist and applying them to the changing conditions as well as supporting them with adequate combinations of force. This factor alone should render us chary of discarding too readily the League of Nations, and should induce us to examine rather more carefully than Mr. Streit has done the causes of its failure or impotency.

Mr. Streit's examination of the League is somewhat warped by preconceived ideas. The League and a federal system are not, as he assumes, necessarily opposed ideas. The League Covenant, for example, lays heavy limitations on national sovereignty, and under it the way is open for gradual and successive further surrenders of national sovereignty until an effective federal scheme is built up. There is at least reason for legitimate doubt whether, if the League has failed because its member States were unwilling to observe its more moderate limitations in their national sovereignty, there is any real prospect at the present time of their entering a federal system which involves an immediate and much more drastic surrender of the essentials of national sovereignty.

Granted that the federal idea probably offers the best ultimate prospect of achieving a lasting peace, the practical question is rather the steps by which we are to advance to that position, more especially when we take into account that the evolution of the British Commonwealth, for example, so far as the Dominions are concerned, is away from any kind of union. In such circumstances, it is imperative to build on any solid foundation that lies to hand.

Reference has already been made to experience and directions in which the work of the League of Nations and of the International Labour Organisation offers hope of further advance or success, and the studies or work on population questions, including migration, and on nutrition are of special promise in this respect. Beyond this we have in being to-day, in the Supreme Council and the Allied High Command, a standing organ of government with a powerful influence over two distinct Sovereign States, and a combination of armed forces under unified control. If these arrangements were kept functioning after the war, a nucleus would be provided on which an international body could be built.

If a way forward to increasingly close combination of European nations is at least possible, the forms of organization which the war is compelling us to adopt for negative purposes could equally be turned to the positive purpose of developing world resources by finding a beneficent outlet for the constructive energies of all peoples. Much progress has been made in establishing successful international commodity schemes, which form instruments of orderly development and are also powerful economic weapons. Steel, tin, zinc, aluminium, rubber, sugar, meat and other vital products are already under some form of international control. The technique of operating such controls is rapidly improving, and consumer interests are being increasingly brought to bear on their operation. This process would be assisted by the creation of an international supervisory body such as a Cartel Commission of the League of Nations, with strong personnel and powers to ensure publicity.

It is difficult to over-estimate the possibilities of such schemes. They have given the world an instrument for the scientific adjustment of expanding production to expanding consumption, thus reducing the chances of further acute world

depressions, with their shocks to the stabilizing factors in international relations. The establishment of wind-breaks against economic blizzards of the severity of those of the period of 1929–32 is essential for peaceful and orderly political development.

Moreover, world economic organization appears to be approaching the point when international finance and trade can be greatly assisted by the concerted use of new methods. Internationally organized marketing, supported by international public works, might now be able to give for the first time a peaceful and lasting outlet for the world's energy comparable in scale with that which war supplied in the past. Already, impartial and scientific studies of such problems, often under the ægis of the League of Nations, have provided a basis for cash and price insurance schemes for the world's farmers, measures of conservation for soil, water, fauna and flora, education and health services and modern systems of taxation in backward countries, on a scale impossible even a few years ago. Here may lie a channel the further scientific exploration of which might provide a solution of the problems of colonies and raw materials.

The fact that in many fields the basis for a scientific attack on outstanding problems has already been provided is at least encouraging, and the possibilities of advance are greater than a quarter of a century ago, even if many difficulties remain. That the problems of reconstruction are already being discussed is a further hopeful sign, and evidence that the mistake of postponing until after victory in war the thought and study concerning the needs and structure of a new Europe will not be repeated. Preparation for the tasks of peace cannot be left until they suddenly and urgently arise, to be dealt with in an atmosphere of bitterness, weariness and economic chaos.

There is much to be said for the immediate appointment of a body of able and far-sighted men, chosen irrespective of party attachment, to begin at once the study of this most vital problem. In that study the co-operation of neutral countries should already be possible, and the way should be open for German co-operation immediately the present tyrannical leadership of that country has been replaced.

The contribution of scientific workers will be essential in the investigation of many of the problems of reconstruction which must be solved if we are to build a new Europe. The scientific spirit must be an effective influence if an impartial solution is to be obtained undisturbed by prejudice or vested interests; and scientific workers no less than other members of the community have their part to play in seeing that the problems of peace are approached now in a magnanimous and serious spirit, with the courage, vision and resolution which are essential if a new order in Europe is to pass from a dream into reality.

ISLAM'S CONTRIBUTIONS TO SCIENCE

La science arabe et son rôle dans l'évolution scientifique mondiale

Par Aldo Mieli. Avec quelques additions de Henri-Paul-Joseph Renaud, Max Meyerhof, Julius Ruska. Pp. xix+388. (Leiden: E. J. Brill, Ltd., 1939.) 12.50 guilders.

IT is only within the last half-century that systematic investigations have been made into the part played by Islam in the development of science. Earlier estimates of its importance were mainly conjectural and thus variable, religious prejudice tending to depreciation and the principle *omne ignotum pro magnifico* to exaggeration. One of the first serious attempts to set the inquiry upon a proper basis, by direct reference to original sources, was made by M. P. E. Berthelot, who in 1893 published the Arabic text of certain Muslim alchemical treatises in his "Chimie au Moyen Âge". Other very valuable pioneer work was carried out by E. Wiedemann (on Arabic chemistry and physics), M. Steinschneider (mainly bibliographical), H. Suter (on Muslim mathematicians), E. G. Browne, L. Leclerc and L. Choulant (medicine), and M. J. de Goeje (geography). More recently, Muslim chemistry and mineralogy have been closely studied by J. Ruska, H. E. Stapleton and P. Kraus; medicine (particularly ophthalmology) by M. Meyerhof; mathematics by Salih Zaki of Istanbul; and Muslim philosophic thought in general by Baron Carra de Vaux and De Lacy O'Leary. This list, though representative, includes only a small fraction of the large band of scholars to whom the publication of very numerous Arabic

texts—with translations, commentaries, glossaries, notes, and all the other impedimenta of learning—is due. Complementing these labours, and indeed often their condition precedent, are such monumental works of reference as the "Encyclopædia of Islam" (now successfully completed), C. Brockelmann's "Geschichte der arabischen Litteratur", and G. Sarton's "Introduction to the History of Science".

Sufficient data have therefore been amassed to make a general estimate of Muslim science both possible and desirable; and M. Aldo Mieli has now provided us with it in the work under notice. M. Mieli, as permanent secretary of the International Academy of the History of Sciences, and himself an erudite historian of science, was in a situation peculiarly favourable to the composition of such a work of synthesis. Enjoying the personal friendship of the leading investigators (some of whom, namely Adnan, Brunet, Meyerhof, Renaud and Ruska, read the proofs), and editing *Archeion*—one of the principal journals devoted to the history of science—he could be sure that nothing of first importance escaped him, while errors would almost certainly be detected. But though M. Mieli was thus fortunately placed for his venture, and though he makes generous acknowledgments to his helpers, it is clear that the main credit for an excellent book is his alone. His material is admirably arranged, his style is clear and pleasant, and the book is well annotated, documented and indexed. It may be read without difficulty by those with a merely general interest in the development of science during an obscure period, but provides also a remarkably useful résumé for the specialist. The bibliographies, though not claiming to be exhaustive, include references to the chief authorities, and are supplemented by lists of various important texts still unpublished: an invitation to scholars which will attract new recruits while spurring on the veterans to further efforts.

In the introduction to his book, M. Mieli points out that Arabic science forms the connecting link between the natural philosophy and technology of antiquity and the scientific knowledge of modern times. To exhibit his subject in the proper setting, therefore, he begins with a short but skilful survey of Indian, Egyptian and Greek science. Even in his self-imposed brevity, he finds space for a dig at the philologists who attempt to interpret classical scientific or technical terms without a knowledge of the science or art concerned. He reminds us of the familiar conception of triremes as ships propelled by three *superimposed* banks of rowers, and says that while this conception is impeccable from the philologic point of view, "un pêcheur quelconque de vos côtes aurait pourtant pu rire au nez de monsieur le philologue qui aurait voulu lui affirmer que de tels navires, si même ils avaient été construits, auraient pu naviguer". In point of fact, as was shown by Lefebvre de Noëttes in 1935, the three sets of rowers in a trireme were disposed horizontally, not vertically.

M. Mieli then proceeds to describe the rise and development of Islam, devoting special attention to the tenets of the Ismā'ilite sect, which had so great an influence upon the later character of Muslim scientific philosophy. The celebrated encyclopædia of the Ikẖwān al-Ṣafā (Brethren of Purity), for example, is permeated by Ismā'ilite doctrine, while according to Kraus the works ascribed to Jābir ibn Ḥayyān were also products of the same sect. In the body of the book, the author treats his subject partly by period, partly by the particular branches of science, and partly under the names of distinguished individual savants such as Al-Bīrūnī, Al-Rāzī and Maimonides. This method allows considerable flexibility and increases the ease with which the book may be read. In less adept hands, it might have led to a staccato scrappiness, but in fact its results here have been very satisfactory

After dealing with Muslim science at its zenith, M. Mieli describes the process, or rather processes, by which it was transmitted to the West. There were at first sporadic and often somewhat curious infiltrations, as for example when the merchant-turned-doctor Constantine the African emigrated from Carthage to Salerno, became a Christian, and inoculated the Salernitan School with a passion for Muslim medicine (eleventh century). More ample contacts between Islam and Latin Christianity were made in Sicily, in Moorish Spain, and through the medium of the Crusades. Countless translations were made, and countless European students sat at the feet of Muslim teachers, so that in a surprisingly short space of time the Arabic version of Greek science, together with the large contributions to knowledge made by the Muslims themselves, became immediately and universally available. By a strange coincidence, the transmission once made, Muslim civilization and science alike evolved rapidly to an irremediable decadence.

The remaining portions of the book deal with bibliographies, with certain Arabic scientists and writers posterior to the thirteenth century, and with the constitution and aims of the International Academy of the History of Sciences. The index of names is divided into three parts: (1) persons who lived before the Hegira, (2) persons living between the Hegira and the end of the twelfth century, and (3) persons living in the Christian West, since the fourteenth century. The last part includes the names of modern authorities.

E. J. HOLMYARD.

A DEFENCE OF VITALISM

Vitalism: Its History and Validity
By Dr. L. Richmond Wheeler. Pp. xii + 276. (London: H. F. and G. Witherby, Ltd., 1939.) 15s. net.

MANY readers of Radl's "History of Biological Theories" and Woodger's "Biological Principles" must have been left with the feeling that biological theories are quite incoherent and biological principles non-existent. Dr. Wheeler has set himself to correct the impression left by such excessively impartial discussions. His book is a history of vitalistic theories and a defence of this point of view. It is a praiseworthy but incomplete attempt to do something extremely difficult. To complete the task satisfactorily would mean a complete history and criticism of the development of scientific thought and its varying background. As vitalism has been an attempt to supplement or set aside the traditional categories of physical science, these have to be examined first. The task is not made easier by the way that vitalists and mechanists in their age-long contest have repeatedly shifted their ground and changed their weapons. If there is a clear and permanent difference between the antagonists, it may be one of temperament as much as anything else. The mechanist is the kind of person who feels that everything important is known already, in principle at least, and that only minor details remain to be discovered. The vitalist feels that existing knowledge is only of minor details, and everything of importance is undiscovered.

The author's brief treatment of the seventeenth and eighteenth centuries is scarcely adequate for the period when the foundations of modern scientific and philosophical thought were being laid. In those days, too, the division of opinion was better defined. The vitalists really believed in 'vital forces'. The mechanists really believed in the all-sufficiency of Newtonian mechanics. In fact, Hobbes believed it when the science of mechanics was scarcely more than a hope and an aspiration. In the nineteenth century the controversy became more confused. The mechanists could not rely on mechanics only but had to add chemistry to their list, regardless of the fact that chemistry was an autonomous science owing very little to physical theory and called mechanical only by courtesy. The vitalists on the other side began to fight shy of vital forces and call them by other names.

In the present century the wholesale reconstruction of physical theory has made further complications. Dr. Wheeler says (p. 172): "Vitalism and mechanism are the only two types of theoretical biology yet devised and both involve the analogy of a humanly constructed machine. Vitalism allows for a mechanic. Mechanism forgets that a mechanic is essential . . ." This is true enough of the traditional controversy and is still true of some of the controversialists, but not of all. If it is true, does it not condemn both sides? The analogy of a humanly constructed machine is, to put it mildly, a dangerous one and may be entirely wrong. There have not been lacking thinkers who pointed this out and for various reasons refused to take either side. Dr. Wheeler is scarcely fair to these 'cross-benchers', and tries to count them in on his side. For example, he scarcely considers the positivists at all. Mach is just mentioned in passing as an anti-mechanist. It is true that positivists deny any absolute truth to mechanical theories, but they are admitted to a secondary sort of truth as "conceptual shorthand" or "convenient fictions" if they help to predict observable facts. But vitalist theories would be utterly condemned as metaphysical and of no heuristic value. Positivism, however seriously mistaken, is an interesting and influential type of theory that should not be ignored. J. S. Haldane, too, is treated as a vitalist, though he always said he was not. His contention was not quite the usual one, that biology is an autonomous science with its own concepts and methods distinct from those of physics, but that the special concepts of biology are really prior to those traditionally used in physics and are really applicable to physics. If physicists have not used them, so much the worse for physics.

Dr. Wheeler sums up his discussion with a list of fourteen arguments in favour of vitalism—all those used by Driesch and several others. What is unsatisfactory about them is that they are all negative. They are designed to show that mechanism is not able to solve all problems and provide an all-sufficient philosophy. The mechanist might reply that he never said it did; he only claims that it suffices to supply all the useful information that has been or is likely to be obtained. There is no answer to this retort unless the vitalist can point to something positive on his side. Driesch's attempt was not a success because he hesitated between the old 'vital force' theory and the view that living organisms have minds, though perhaps very little ones. Neither view is necessarily absurd, nor if carefully interpreted need it contradict established facts or physical principles; but it is of no value unless it is consistently maintained, and applied in detail to specific cases.

The vitalist's demand for biology to use its own special methods and concepts can be readily granted, provided he can tell us what they are. A purely physical science like meteorology does this very thing. To-morrow's weather might be predicted by calculation using the general laws of thermodynamics and the kinetic theory of gases; but actually it is done by using purely *ad hoc* meteorological concepts and methods. If these concepts can be shown to be derived from the general theory of physics, so much the better; but if not, that is not a fatal defect. Similarly, if one wants to know the density of lead, the viscosity of glycerin or the structural formula of cane sugar, one does not find the values by calculation from the theory of atomic structure. Even if this were possible, it would take too long and give very inaccurate results. It may be suspected that results would only be forthcoming at all when the answer was known beforehand. The function of the general theory is merely to show that what has been accurately determined empirically is roughly the kind of thing that might be expected. In biology every investigator uses *ad hoc* concepts and methods while he is investigating, but as the concepts are difficult to define he may forget about them when he is arguing. For this reason, the Gestalt school of psychologists have done very valuable work in producing special concepts that are sufficiently well defined, can be applied to specific cases, and act as guides to experimental investigation. If as Kohler maintains, Gestalt principles are equally applicable to physics, that is a point in favour of Haldane's view. Dr. Wheeler probably agrees to all this, but he is not very explicit about it. A. D. RITCHIE.

A USE FOR EVERY CHEMICAL

Uses and Applications of Chemicals and Related Materials

A Guide to the Current Industrial Uses, Potential Applications and Sales Possibilities of 5167 Products. Compiled and edited by Thomas C. Gregory. Pp. vi + 665. (New York: Reinhold Publishing Corporation; London: Chapman and Hall, Ltd., 1939.) 60*s*. net.

THIS is a book for which many of us have been waiting. Whilst to the more academic among chemists individual chemical substances are mainly of interest on account of their properties, the elucidation of the finer points in their structure or for use in chemical reactions, there is also a large corps of chemists who, aided by engineers, technicians, physiologists and others, are engaged in finding a useful application of as many of them as possible to the better service of humanity.

The last decade has been outstanding in regard to the discovery that all sorts of what may be described as laboratory curiosities can be made to serve useful ends. Practical work of this nature requires a peculiar aptitude which is more common in the United States than in Britain. There also the willingness of the manufacturer to try something new, because it is new, encourages such developments. The point has often been emphasized in the columns of NATURE; perhaps its reiteration at a time when war emergencies are promoting invention will serve a useful purpose.

As the sub-title indicates, the book lists in alphabetical sequence a large number of substances which can be classed as chemicals, including a high proportion of synthetic organic materials. Against each substance is listed its uses, set out under industries again arranged in alphabetical order.

For some substances the uses are already numerous; with others they are limited. It becomes possible very quickly to see whether a use has been found for a particular substance and for what kind of purpose. Thus, turning over the pages at random, ethyltriphosphonium bromide may be used as an agent for moth-proofing furs, feathers and the like as well as textiles.

Montan wax has twenty-seven uses in such diverse industries as electrical, food, ink, leather, metallurgy, paint, paper, perfumery, rubber, textile, etc., all of which are set out succinctly.

Again, orthodichlorobenzene has been applied in freeing hydrochloric acid from arsenic, as an intermediate in making dyestuffs, as a cleansing and polishing agent for brass and as a solvent in all four very varied purposes.

The collection of the material was begun in 1922 by the late Ismar Ginsburg and was continued and expanded since 1933 by Thomas C. Gregory. Most of the data have been published in the *Oil, Paint and Drug Reporter* regularly since 1922, where supplementary surveys covering additional products and new uses will continue to appear.

The practical value of the book need not be further stressed; the only criticism from the point of view of the British reader is the high cost, which will restrict its circulation here.

E. F. A.

MATHEMATICAL METHODS IN ECONOMICS

Économie théorique et statistique économique (1) Théorie mathématique de la valeur en régime de libre concurrence. Par J. R. Hicks. Pp. 56. 18 francs. (2) Les fondements mathématiques de la stabilisation du mouvement des affaires. Par Prof. J. Tinbergen. Pp. 114. 30 francs. (Actualités scientifiques et industrielles, 580 et 632.) (Paris : Hermann et Cie, 1937–38.)

IN the classical economics of Marshall, it was assumed that a consumer spends his income so as to obtain the maximum possible 'utility', and it was deduced that the prices of commodities must be proportional to their marginal utilities. The weak point of this is that no one knows exactly what this utility is, and still less how it can be measured. Modern mathematical economists, in particular E. Slutsky, J. R. Hicks, R. G. D. Allen, have, by developing Edgeworth's 'indifference curve' and Pareto's 'scale of preference', succeeded in constructing a theory of value on a new and much sounder basis. All that is assumed is that the consumer knows, of the various sets of goods purchasable for a given sum, which he likes best, which second best, and so on. It is amazing how this apparently inadequate postulate is adapted to mathematical treatment, including the use of the differential calculus to determine the maximum satisfaction obtainable with a limited amount to spend.

Consider any set of numbers the order of magnitude of which indicates a consumer's order of preference without any pretence of measuring its magnitude. These form a function of u. The most general 'index of preference' is an arbitrary function of u. The marginal utility is also arbitrary, but the ratio of two marginal utilities has a definite value, as the arbitrary factor cancels out. This ratio is called the marginal rate of substitution, and is fundamental in the new theory. All the old work involving marginal utility can be employed, provided that the conclusions do not involve the arbitrary function.

One of the most important results is Slutsky's 'fundamental equation of the theory of value', which can be interpreted in terms of Marshall's elasticities. Further developments include the general equilibrium of exchange and of production ; but it is not necessary to describe these in detail, as the novelty of the work lies in its premises rather than in its conclusions. Prof. Hicks's tract is written for those with considerable mathematical attainments ; a comparatively non-mathematical account, with extensions to a much wider field, will be found in his "Value and Capital".

We now come to a more difficult branch of mathematical economics, dealing with the case when there is a time-lag between cause and effect. As a first approximation, Prof. Tinbergen makes a number of simplifying assumptions, such as that sales, profits and investments depend, not on the actual prices, wages and interest, but only on their mean values. Thus, in this 'macrodynamic approximation', production and prices are treated as a whole ; the variables are really index-numbers. Moreover, certain phenomena which are considered of minor importance, such as the excess of imports over exports, are entirely ignored. He now sets up a large number of equations, based partly on general economic ideas and partly on a careful statistical analysis of conditions in the United States (1919–1932). For example, one equation asserts that the mean price is proportional to the mean amount of sales nine months before, another that the rate of bank interest depends on the balance six months before.

In their general forms these equations are difficult to handle, but if we consider only variations from an equilibrium level, we get, with further approximation, a system of linear finite difference equations with constant coefficients, which are easy to solve. The solutions may be used for two purposes. First, they show how the conditions at a given period can be calculated from a knowledge of those at an earlier period. This is tested by a series of graphs, and the agreement between the calculated and observed results is much closer than might have been expected, in view of the extensive approximations made in the course of the work. Secondly, they show how the general nature of the solution depends on the values of the coefficients, and so how the magnitude of economic fluctuations can be diminished by Government action. Specific recommendations are drawn up for the consideration of the United States Government.

Lack of space compels us to pass over many extensions and applications of the author's method, such as the effect of external perturbations, of speculation, and of fixing salaries or prices. He gives a great deal of matter the importance of which may not be generally realized until it is available in a more extended form. But what seems most valuable is not so much any detail of the work as the general spirit. Physics and other sciences have made great progress because of the constant interaction between observation and theory, and it is likely that this method will prove equally fruitful in economics.

H. T. H. PIAGGIO.

SCIENTIFIC CENTENARIES IN 1940

BY ENG.-CAPT. EDGAR C. SMITH, O.B.E., R.N.

IN looking back once again for the names of men who were born or who died, one, two, three or more centuries ago, to whom the world is indebted for some discovery, or contribution of note to the progress of modern science, the first name which stands out clearly is that of William Gilbert, the physician of Elizabethan days. He was born in 1540. When sixty years of age he published his famous book "De Magnete, magnetisque corporibus et de magno magnete tellure". This was the first great work on physical science published in England. A century or so after Gilbert died, Dryden wrote the lines

"Gilbert shall live till loadstones cease to draw
Or British fleets the boundless ocean awe."

Gilbert was born at Colchester towards the end of the reign of Henry VIII. At the age of twenty he graduated from St. John's College, Cambridge. He afterwards spent some years in travel and study on the Continent and in 1569 obtained the degree of M.D. Four years later he settled in practice in London and ultimately became physician to Queen Elizabeth. His home was in St. Peter's Hill, and one of his haunts was the College of Physicians, then housed in Linacre's house in Knight-Rider Street not far from St. Paul's. He rose to be president of the College; and to it he bequeathed his books, globes and apparatus, but these were all destroyed in the Great Fire of 1666. He died at Colchester on November 30, 1603, and was buried in Holy Trinity Church, in which a monument was erected by his brothers.

Gilbert's experiments in magnetism and electricity mark an epoch in science in Great Britain. They were fully appreciated by some of his contemporaries and Galileo, in one of his "Dialogues", makes the imaginary Salviati say of the "De Magnete": "I highly praise, admire and envy this author for having formed such a stupendous conception on a matter which has been treated by many sublime intellects, but solved by none. . . . I do not doubt that in due course of time this new science will be perfected by new observations and by true and cogent demonstrations. But the glory of the first inventor will not be diminished thereby. . . ."

Another celebrated man of science who was born in 1540, and who died in 1603, was the French algebraist François Viète, commonly known as Vieta. Born at Fontenay-le-Comte, Vendée, he was educated for the law and for some time practised at the bar in Paris. When forty years of age he was given the post of master of requests, attached to the Parliament of Paris, and from that time he gave up his leisure to mathematics. Of the three books printed during his lifetime—for private circulation—the first was his "In Artem Analyticam Isagoge" (1591); this is the earliest work on symbolic algebra. In his article on Vieta, in the old "Penny Encyclopædia", the mathematician Augustus de Morgan wrote: "If a Persian or Hindu, instructed in the modern European algebra, were to ask 'Who of all the individual men made the step which most distinctly marks the separation of the science which you now return to us from that which we delivered to you by the hands of Mahommed ben Musa?' the answer must be Vieta."

Among the French mathematicians born a century after Vieta were Jacques Ozanam (1640–1717) and Phillippe de Lahire (1640–1718). The former wrote nearly twenty books, but he is remembered to-day for his four volumes of "Recreations Mathematiques et Physiques". The youngest son in a well-to-do family, Ozanam was intended for the Church. This prospect, however, had no appeal for him, and he became a teacher of mathematics at Lyons. He there appears to have developed a passion for gaming, but some time afterwards he removed to Paris and devoted himself entirely to mathematics and was elected to the Royal Academy of Sciences. It is said that when religious matters were being discussed he remarked "that it was the business of the doctors of the Sorbonne to dispute, of the Pope to decide, and of a mathematician to go to heaven on a straight line". His contemporary Lahire was the son of a court painter and it was hoped he would become one, but geometry proved too strong an attraction. In his thirties he began observing at the newly erected Paris Observatory where Cassini was similarly employed. By the Minister Colbert he was appointed to assist Picard in geodetical work for the chart of France. He wrote a variety of works and from 1690 onwards held a professorship in the famous Collège de France.

The year 1640 also saw the birth of Dr. Robert Plot (1640–96), author of natural histories of Oxfordshire and Staffordshire, a secretary of the Royal Society and the editor of vols. 143–166 of the *Philosophical Transactions*. When Elias Ashmole established the first University chemical laboratory at Oxford, it was placed under Plot's charge.

The bicentenaries which occur this year recall, among others, the names of two authors concerned with those indispensable works—encyclopædias. In May 1740 Ephraim Chambers died and was buried in the cloisters of Westminster Abbey. As a youth he had come to London from Westmorland to learn globe-making at the hands of Senex. From globe-making he turned to writing and, conceiving the plan for a dictionary of science, took chambers in Gray's Inn and there in 1728 produced his "Cyclopædia, or . . . Dictionary of Arts and Sciences". It immediately won a reputation for him and he was elected F.R.S. Several editions of his work appeared and it formed the basis of the Cyclopædia of Dr. Abraham Rees (1745–1823). In between the publication of the encyclopædias of Chambers and Rees came that of the "Encyclopædia Britannica" (1771), projected, printed and published by the public-spirited Edinburgh printer and naturalist William Smellie, who was born the year Chambers died.

The record of scientists, inventors and pioneers born in 1740 includes the names of Henry Cort (1740–1800), whose patents of January 17, 1783, and February 13, 1784, for the production of wrought iron plates, bars and rods form a milestone in the history of our iron industry; of Joseph Michel Montgolfier (1740–1810), who with his brother Jacques Etienne Montgolfier (1745–99) made the pioneering experiments with balloons; of the astronomers Thomas Bugge (1740–1815) of Copenhagen, Jacques Andre Mallet (1740–90) of Geneva, Andre Jean Lexell (1740–84) of Sweden and St. Petersburg, and of the famous geologist, physicist and mountaineer, Horace Bénédict de Saussure (1740–99). Like Mallet, de Saussure long held a chair in the University of Geneva, but it was his travels, his observations of rocks and his climbing expeditions which contributed most to his renown. His excursions culminated during the years 1787–89 with the ascent of Mont Blanc, a stay for thirteen days on the Col du Géant, and a tour of Monte Rosa. Mont Blanc, it may be added, was first climbed in 1786 by the hunter Jacques Balmat and Dr. Paccard.

Some of the eminent men of science who died in 1840 were referred to at the anniversary meeting of the Royal Society of that year. Among these was the French mathematician Simeon Denis Poisson (1781–1840); the German anatomist and naturalist Johann Friedrich Blumenbach (1752–1840) and the German astronomer Heinrich Wilhelm Matthäus Olbers (1758–1840). Olbers and Blumenbach when they died had passed the allotted span of life, but Poisson, apparently by his unceasing labour and his neglect of exercise and healthy recreation, had shortened his life. From a boy upwards he had been a prodigious worker. He was a younger contemporary of Lagrange, Laplace, Fourier, Monge, Prony and other members of the brilliant group of scientists in Paris during Napoleonic and post-Revolutionary times. He occupied positions at the École Polytechnique, the Collège de France, and the Bureau des Longitudes. "If he was inferior to Fourier or to Fresnel," said an obituary in the *Athenæum*, "in the largeness and pregnancy of his philosophical views, he was incomparably superior to them in mathematical power: if some of his contemporaries rivalled or surpassed him in particular departments of his own favourite studies, he has left no one to equal him, either in France or in Europe at large, in the extent, variety, and intrinsic value of his labours".

Five others who died in 1840 were Joseph Johann von Littrow (1781–1840), the Bohemian astronomer who from 1821 was director of the Vienna Observatory; André Jean Francois Marie Brochant de Villiers (1772–1840), who with Elie de Beaumont and Dufrenoy made a geological map of France; Nicolas Aylmer Vigors (1787–1840), the Irish M.P. who was a founder and the first secretary of the Zoological Society; Sir Anthony Carlisle (1768–1840), the surgeon who with William Nicholson on May 2, 1800, decomposed water with the aid of the first voltaic pile made in England, and Sir Robert Seppings (1768–1840), an eminent naval constructor in the days of our 'wooden walls'.

Seppings was a shipwright apprentice in 1782, master-shipwright at Plymouth in 1800, and at Chatham in 1804, and in 1813 was appointed surveyor to the Navy, a post he held until 1832. He introduced a form of keel blocks for dry docks which enabled ships to be dealt with rapidly, and a system of diagonal trussing for ships which was extensively used. In 1818 he was awarded the Copley Medal of the Royal Society for his communications on warship construction. He died at Taunton on April 25, 1840, and his monument is in St. Mary's Church.

Of men of science born a century ago in Germany one of the most notable was Ernst Abbe (1840–1905) whose optical investigations, combined with the work of the instrument-maker Carl Zeiss (1816–88) and the glass-maker Otto Schott, made "Jena glass" famous the world over and Zeiss instruments the standard of excellence. Abbe was a professor in the University of Jena at the age of twenty-six he became associated with Zeiss. After Zeiss's death he was responsible for the business, which he formed into a sort of trust called the Carl Zeiss Stiftung. Speaking at the Optical Convention of 1905, shortly after Abbe's death, Glazebrook said that "Abbe's work in Jena is perhaps the most striking illustration of the way

in which progress depends on the co-operation of science and experience". Another German physicist born in 1840 was Friedrich Kohlrausch (1840–1910), the successor of Helmholtz and the predecessor of Warburg, as president of the Reichsanstalt at Charlottenburg. In France 1840 saw the birth of Emile Duclaux (1840–1904), an early assistant to Pasteur, who after his master's death became director of the Pasteur Institute.

Sweden has long been famous for its chemists and metallurgists, and among the former are Lars Fredrik Nilson (1840–99) and Per Theodor Cleve (1840–1905). Both studied at Uppsala, both held chairs there and at Stockholm and both were elected foreign members of the Chemical Society. The memorial lecture to the Society on Nilson was given by Prof. Otto Pettersson and that on Cleve by Sir Edward Thorpe. Speaking of the position Sweden occupied in relation to chemistry, Thorpe said that "when regard is had to her position among continental nations—to her chequered political history, to her geographical isolation, the comparative sparseness of her population, her relative poverty, the fewness of her seats of learning—the influence which Sweden has been able to exert on the development of that branch of science, which it is the proper function of this Society to foster, must always excite our wonder, admiration and gratitude. The mere mention of the names of Bergmann, Scheele, Berzelius, Mosander, Gadolin, Nilson, is sufficient to remind us how great have been her services to the science of chemistry".

To this necessarily incomplete list of men distinguished in science, invention or engineering may be added the names of the American geologist Edward Drinker Cope (1840–97); the American-British inventor and engineer Sir Hiram Stevens Maxim (1840–1916); the Irish astronomers Lord Rosse (1840–1908) and Sir Robert Stawell Ball (1840–1913); the Scottish inventor John Boyd Dunlop (1840–1921) of pneumatic tyre fame; the English metallurgist James Riley (1840–1910), and the great civil engineer Sir Benjamin Baker (1840-1907), whose name will always be remembered in connexion with the Forth Bridge, the Aswan Dam and other important constructions. Baker was elected F.R.S. in 1890, and served as president of the Institution of Civil Engineers in 1895. He died at Pangbourne on May 19, 1907, and was buried at Idbury, in the Cotswolds. On December 3, 1909, a memorial window to him was unveiled in the north aisle of the nave of Westminster Abbey.

FOOD FROM GARDENS AND ALLOTMENTS

By Sir John Russell, F.R.S.,
Rothamsted Experimental Station

THANKS to numerous official inquiries, the quantities of food required by the population of Great Britain are fairly well known. Our diet is both generous and varied. The total food consumption averages rather more than 900 lb. a head without counting milk and eggs. Apart from these the *per capita* consumption falls into five groups: about 200 lb. each of (1) wheat, (2) potatoes, (3) other vegetables and fruits, and (4) meat and fish combined; (5) some 140 lb. of other foods, chiefly sugar (94 lb.) with smaller quantities of butter (25 lb.), margarine (8 lb.) and cheese (10 lb.).

We produce at home all the potatoes, the liquid milk, and much of the vegetables; about half the meat and fish, but only 15 per cent of the wheat and some 10 per cent of butter. We produce rather less than 40 per cent of the total money value of our foods, and rather less than 50 per cent of the total weight. On an average, for each individual there is in peace time an import of about 4 cwt. of food per annum.

One of the most urgent problems at the present time is to reduce this figure. It is made up roughly as follows:

Wheat	1½	cwt.
Meat and fish	1	,,
Fruit, butter, cheese, etc. ..	1	,,
Sugar	60	lb.
Total	4	cwt. approximately

The largest item is wheat, of which 170 lb. is imported out of the 200 lb. consumed. We shall, however, produce more. The plan of the Ministry of Agriculture is to plough up two million acres of land in all; in the War of 1914–1918, when this was nearly accomplished, we had added 50 per cent to our wheat production.

If we succeed in doing as much this time, we shall reduce the 170 lb. of imports to 155 lb., but it seems scarcely likely that we can get much below this. Something could be saved by closer milling, but that would only mean less food for our animals and therefore less meat and milk. For one thing we have insufficient land available;

wheat is one of the least economical of all crops to grow so far as land is concerned, for while 1 acre of wheat suffices only for 6–7 persons per annum, 1 acre of potatoes suffices for 70–75.

For meat and fish our imports are about 110 lb. annually out of a total consumption of practically 4 lb. per week per head. Consumption could be cut down by rationing; but in view of the circumstances that our animal population is now larger than it has ever been before, it seems improbable that there will be much shortage during the first year of the War. Even our animals, however, have been living on imported food, though not to the same extent as ourselves; Dr. Wright recently estimated that some 25 per cent of their total food is imported.

The area of land being limited, all increased allocation of land for human food means a reduced area for the growth of food for animals. During the War of 1914–1918 the annual production of milk fell by 400 million gallons, a reduction of 20 per cent, while that of meat fell by 170,000 tons, a reduction of 17 per cent. There were various contributory causes and we shall hope in this War that the fall will not be so great. In seeking to increase production of human food we must not, however, forget our animals.

The import of fruit will be difficult to replace. The Englishman's favourite fruits are bananas, oranges and apples, and two of these must be wholly imported while of the third we produce only a fraction of our total consumption.

Another big item in the import bill is sugar; the 60 lb. of import can be cut down by rationing; we can produce more at home than we are doing and we shall, it is hoped, also make better use of bees. From a reasonably well-kept hive one should obtain some 40 lb. of honey, though this is not a net gain because it involves the feeding of some 10–20 lb. of sugar to the bees. On dairy produce we cannot hope to save much. If there were no waste the ration of ¼ lb. of butter per week would give us 13 lb. a year, not far short of the 16 lb. which was our average until recently.

The most hopeful direction of saving shipping is therefore to economize on meat, fruit and sugar, at the same time increasing our home production of wheat and also of animal food so as to avoid the necessity for reducing home production of milk and of meat.

The question to be decided then is: What part can gardens and allotments play in this programme of production?

Experience in the War of 1914–18 shows that production of potatoes can be readily expanded and with great advantage in every way. The production rose in the last war from 7·5 million to 9·4 million tons—an increase of nearly 25 per cent. Potatoes are not only valuable as food for men and for animals; they are also an important source of starch for various other purposes. They are easy to grow and responsive to treatment.

Vegetables will become of increasing importance as the meat ration is cut down; but unfortunately, while the English gardener can produce them at least as well as anyone else, the English cook usually treats them deplorably. The great difficulty about reducing our meat ration will be that we may be presented with a succession of vegetarian dishes, made dull and tasteless, not through any fault of the vegetables, but because of the incompetence of the cook. For this reason it is very important in any garden or allotment that there should be as wide a variety as possible of vegetables, including particularly those used for salads, and those that can be made up into tasty dishes. Food value is probably of less importance than tastiness; it seems improbable that our dietary would ever be so seriously curtailed as to be lacking in actual food value; the present danger is that it may lack variety and no longer be appetizing. This the gardener should seek to remedy.

It seems inevitable that sooner or later we must face a reduction in the amount of fruit that we usually import; we can scarcely hope to continue our present supplies of oranges and bananas and imported apples. In many gardens there are fruit trees and bushes in a more or less neglected condition. If these were overhauled they might be made to yield better during the coming season; the produce may be very welcome, for the deficiency of fruit must somehow be made good both by growing more at home and by using more vegetables.

The increased garden production of potatoes and vegetables would have several important advantages quite apart from ensuring supplies for the grower's table. Farm land now used for the production of potatoes and vegetables could be released for other purposes, especially for the production of fodder crops for animals, thus saving the necessity for uneconomic slaughter and ensuring continued milk and meat production.

Much internal transport could also be saved. At the present time many parts of Great Britain are not self-supporting in potatoes and vegetables, and considerable quantities have to be transported from county to county, occupying valuable truck space or using up petrol on the roads. It would be a great advantage if this internal transport could be cut down.

The possibilities of increase are considerable. It is estimated that there are some 3½ million gardens and 900,000 allotments in the country. The Ministry of Agriculture is stimulating the formation

of new allotments, aiming at establishing another 500,000. Many of the existing gardens and allotments are not, however, fully used, and it is desirable to improve them as speedily as possible. Technical advice is now available in every county. There is, however, a real danger of considerable waste of seed and manure, neither of which can well be spared now. Here there seems a useful opening for local distribution that could ensure distribution of manure and interchange of seedlings so as to avoid the present wasteful methods. Distribution of excess produce is another important problem, for however well the garden is planned it is impossible to avoid an excess at one period and a deficiency at another. Unfortunately, organization of garden production is peculiarly difficult and in the past has rarely succeeded, but that is no reason why it should not again be attempted, as in the last war. Finally comes the important question of utilization of garden wastes; the best way, the keeping of pigs and poultry, is not usually possible. In any event, even if these are kept, the compost heap is an essential part of a good gardener's equipment.

THE EARTHQUAKE IN TURKEY

By E. TILLOTSON

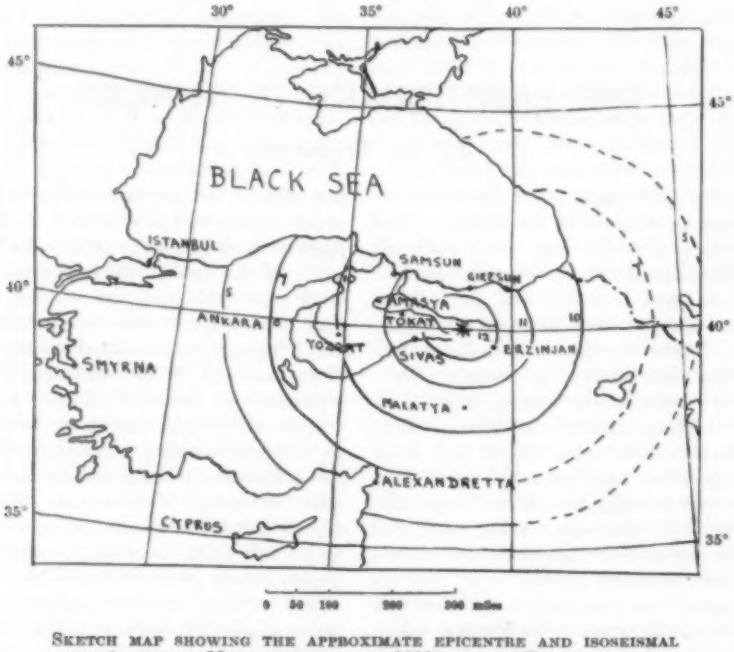
THE greatest earthquake ever recorded in Turkey, and probably the greatest natural catastrophe which Turkey has ever suffered, occurred on December 27, when, between approximately 1.57 a.m. and 5 a.m. local time (East European), there were at least seven terrific earthquake shocks. These shocks caused havoc on and near the Black Sea coast of Anatolia in north-eastern Turkey, where, to the accompaniment of underground rumbling, upwards of fifteen towns having populations of between fifteen and forty thousand persons each, together with more than ninety villages, were practically razed to the ground, communications by telegraph, road and rail destroyed, and estimated casualties of 45,000 killed and 20,000 wounded caused.

The first news of the catastrophe was received from the Bendandi Observatory at Faenza, which reported that an earthquake of catastrophic dimensions was registered on its seismographs at 1 a.m. (Mid-European time). The earthquake was estimated to have taken place in Armenia, and the vibration at Faenza was so intense that the recording instruments were damaged. Similar news came from the Swiss observatories, and at Zurich the shock was received at 1.2 a.m. (Mid-European time). The seismograph belonging to Mr. J. J. Shaw at West Bromwich was also damaged by the earthquake, though Mr. Shaw was away from home at the time. Shortly after the news from Faenza, messages were received from Ankara stating that earthquake shocks had been experienced there.

The full force of the principal shock was felt at Erzinjan, a town situated at an altitude of 4000 ft. above sea-level where a brisk trade was conducted in silks, cotton and copper. The town was immediately reduced to a heap of ruins and about 80 per cent of the population killed. The upsetting of oil lamps and stoves and the breaking of gas pipes caused hundreds of fires to break out in all parts of the town, which the surviving brigades could not extinguish on account of broken pipe lines and huge cracks in the roads. Telephone and telegraph communications were also disrupted. Here, included in the wreckage, were the military barracks and club and military school, where ten officers and ninety cadets are known to have lost their lives, though a much greater military death roll is feared. Damage only a little less severe was done at many other towns. Sivas, a town of 65,000 inhabitants, the centre of caravan routes and a collecting place for the agricultural produce grown in the surrounding districts, together with Tokat in Sivas Province, a town of 31,000 inhabitants engaged largely in calico manufacture, and the intervening villages, were practically wholly destroyed. Many people, in bed at the time of the first shock, were buried alive in the wreckage of their homes. The district of Kemah, the town of Yozgat and the town of Amasya, with a population of 30,000, in the midst of fruit-growing country, are all in ruins. At Samsun in the Trebizond district, a seaport with a population of 15,000, exporting copper, timber, tobacco, wool and other agricultural products, mosques, minarets, schools and public buildings—some of them built of reinforced concrete—and private houses came crashing down, killing thousands of people. Ordu, in the tobacco-growing district, suffered similarly, as did also Giresun, Malatya, Turhal, Gumushane, Refahive and Plumer. On the night of December 28 fires were still blazing amidst the ruined buildings, and to add to the difficulties of the rescue parties a blizzard was raging in the countryside at a temperature of 2° F. Of the 350 inhabitants of

the village of Tomruk, only three survivors have been traced. The single-storied mud houses of the peasants suffered terribly.

The first relief train on the recently opened Sivas-Erzerum railway was held up just outside Sivas because of wreckage on the line, twisted rails and huge ground fissures. Most of the geological faults already known in the area have moved, causing large crevices and permanent lateral movement. One of the principal faults along which movement has taken place has been estimated by the director of the Istanbul Observatory to be sixteen miles deep, and many new faults have been formed.



SKETCH MAP SHOWING THE APPROXIMATE EPICENTRE AND ISOSEISMAL LINES (MODIFIED MERCALLI SCALE OF 1931) OF THE ERZINJAN EARTHQUAKE OF DECEMBER 27, 1939.

°, EPICENTRE; —10—, ISOSEISMAL LINE.

On the basis of the macroseismic data, the accompanying sketch map showing the isoseismal lines has been constructed. The scale used is the modified Mercalli scale of 1931 originated by H. O. Wood and F. Neumann for the Carnegie Institution of Washington and the United States Coast and Geodetic Survey. This scale is numbered 1–12 in ascending order of earthquake intensity, 1 being a shock not felt except by a very few under especially favourable conditions, and 12 being a shock where the damage is total, waves being seen on ground surfaces, lines of sight and level distorted and objects thrown upward into the air. It is extremely rare for a shock to have intensity 12, though many of the great earthquakes described by Davison, and the Chilean earthquake of January 24, 1939 (NATURE, February 11, 1939, p. 230), probably exceeded scale 11, which indicates that few if any masonry structures remain standing, broad fissures exist in the ground, underground pipe lines completely out of service, and rails bent greatly. Scale 7 indicates that damage has been negligible in buildings of good design and construction but considerable in poorly built or badly designed structures, whilst scale 5 shocks are felt by nearly everyone, break some dishes, crack some plaster and overturn unstable objects. It should be noticed that such intensities are influenced by ground conditions as well as by the energy causing the displacements, and, since buildings once cracked may succumb to prolonged shaking, the total period of shaking would appear to be an important factor.

The greatest of the shocks was certainly world-shaking so far as modern seismographs are concerned, since these are capable of registering measurable ground displacements of less than 5 μ (where $\mu = 0{\cdot}001$ mm.). It was registered at observatories throughout the British Isles and in the world in general. The fact that seismographs as far away from the epicentre as West Bromwich which were set for normal earthquakes were dis-

located appears to show that the surface waves *L* and *M* as distinct from the body waves *P* and *S* were of very large amplitude, indicating the release of a tremendous amount of energy from a normal or shallow focus. This also appears to be confirmed by the relatively quick decrease of destructiveness in all directions moving away from the epicentral area. The news from Istanbul Observatory also appears to indicate that the greatest focal depth of any one shock was sixteen miles.

The principal shock is estimated to have shaken the devastated area for a period of some twenty seconds, though seismograms from distant observatories occupy a much longer period of time on account of the variation in velocity of the different waves sent out by the earthquake. The epicentre of the principal shock appears to have been near latitude 40° N., longitude 38·5° E. and the initial time of the first shock about 1.57 a.m. local time (East European) or 26d. 23h. 57m. G.M.T. It must not be thought that all the seven or more shocks originated at the same time or from the same epicentre, as there is evidence to support the hypothesis that the epicentres of the shocks wandered east and west along latitude 40° N., the first being some seventy miles east of Ankara, and later southwards along approximate longitude 39° E. Also it appears to be more correct to speak of an epicentral area rather than an epicentrial point. Aftershocks have continued to be numerous and severe. These, too, appear to be peripatetic along the lines above mentioned, and as yet the diminution according to the usual exponential law does not seem to have become evident. Shocks were still occurring up to December 31, and on that date a violent shock was reported at Bergama, on the Ægean coast.

On December 31, serious floods followed the earthquakes. These have caused further casualties and damage to houses and communications. It is now estimated that the entire population of Erzinjan, Trebizond, Tokat, Sivas, Ordu, Samsun and Amasia, totalling about two millions, are without shelter.

More than five hundred villages in the Brusa region have become marooned, and the Izmid Gulf area is totally submerged. Intermittent, though less intense, shocks occurred in eastern Anatolia on January 1. On the same day, the towns of Karacabey, Manyas and Yenisehir became inundated by the flood water, and the Rivers Nilafur, Halife and Karadere changed their courses. More villages were marooned later in the day.

It is estimated that the devastated area covers about 15,000 square miles, which is about one twentieth of the country.

A third disaster occurred on January 1, when severe storms broke out over the Black Sea causing serious damage to shipping.

On January 2, the floods became more extensive in western Anatolia, where the Sakarya River overflowed and flooded the Bilecik valley. Light tremors were still occurring.

It has been noticed previously by Dr. C. Davison and the late Prof. H. H. Turner that violent earthquake shocks appear to be followed almost immediately by sympathetic shocks in various parts of the world and often at the antipodes. It may be that at these places where sympathetic earthquakes occur there already existed a state of tension (or compression) in the strata and 'layers' which almost amounted to unstable equilibrium, and that it only needed the trigger action of another shock in lieu of some other factor to release the energy and produce the sympathetic earthquake. The Anatolian shock was particularly violent, and therefore it was no surprise to find earthquakes occurring in other parts of the world. On December 27 about 7 a.m., San Salvador in Central America, near to which there was an earthquake on December 5, experienced earthquake shocks, as did Los Angeles in California on the same day. These are both reported to have been strong shocks, though no damage was reported. Between December 27 and 28, twenty-five earthquakes and earth tremors, two of which were of sufficient intensity to rattle crockery though none did any material damage, shook the gold-mining district of the Rand near Johannesburg in South Africa. On December 27 also, at Tangier, the north African port, deaths were reported as being due to a strong earthquake there. Previously, in 1784, Erzinjan was devastated by a severe earthquake, though the shock does not seem to have been so severe as on the present occasion.

It must be remembered that the whole of Asia Minor is a seismic zone for small shocks, as is seen by the fact that Miss Bellamy has catalogued 280 shocks as having occurred in and around Turkey between 1913 and 1930, though earthquakes in this region appear to have been stronger and more numerous of late (prior to the present shock). On September 22, 1939, two hundred people were reported killed during an earthquake which occurred in the Smyrna district (NATURE, September 30, p. 589). Damage and casualties occurred also in the villages of Pergame, Kotchili and Fotcha. Then so recently as November 23 last, an intense shock destroyed six villages in Anatolia (NATURE, December 2, p. 938), killing forty-three people besides injuring many more.

Further news of the present disaster must await the restoration of communications in the afflicted area, and the careful study of the seismograms in observatories throughout the world.

THE PALAO TROPICAL BIOLOGICAL STATION

By PROF. C. M. YONGE,
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THE history of the investigation of coral reefs reveals the fascination these unique marine communities have exercised over the imaginations of zoologists. One thinks of Darwin at Cocos Keeling, of Dana on the United States Exploring Expedition, of Murray on the *Challenger*, of Alexander Agassiz who sailed over all tropical oceans, of Gardiner and Sewell in the Indian Ocean, of Mayor at the Tortugas and at Murray Island and Samoa, of Crossland in the Red Sea and in Tahiti. In more recent years exploration and description have given place to studies of a more physiological nature, and research has been localized around permanent or temporary marine laboratories. Mayor led the way at the Tortugas and was followed by the Dutch at Batavia, by the Great Barrier Reef Expedition at its temporary laboratory at Low Isles and by the University of Egypt on behalf of which Crossland established the marine laboratory at Ghardaqa in the Red Sea.

Now a new centre of research has been established by the Japanese on Korror Island, one of the Palao (Pelew) group situated in the western Pacific some eight degrees north of the equator. The Palao Tropical Biological Station owes its inception to the activities of the Japanese Society for the Promotion of Scientific Research, the site of the station being selected by Prof. Shinkishi Hatai of the Tôhoku Imperial University, Sendai. The Laboratory, which was opened in April 1935, consists of a series of single-story wooden huts admirably suited for work in the tropics. It is surrounded by water which varies in temperature only between 28° and 31° C. and is rich in coral. Since its establishment a continuous stream of biologists have been sent to the Station from Japan and the results of their work are contained in the pages of the *Palao Tropical Biological Station Studies*, the first volume of which has recently been completed.

The most important sections of this work are concerned with corals. No fewer than 116 species, belonging to 43 genera, have already been identified, and these are listed in a systematic paper by M. Eguchi. This number compares with 117 species of 41 genera recently reported by Umbgrove[1] from the Bay of Batavia, probably the scene of the most intense collecting in the tropical Indo-Pacific.

Dr. Noboru Abe, of the Asamushi Marine Biological Station, contributes a series of papers dealing with the unattached coral, *Fungia actiniformis* var. *palawensis*. The eggs are fertilized while still in the gonad and therein develop into planulæ. These are liberated about the time of new moon every month from September until April, a condition which recalls the similar regular planulation of *Pocillopora bulbosa* recorded by Marshall and Stephenson at Low Isles[2]. Post-larval development is described and figured, the animal being capable of capturing active copepods about the fifteenth day. In a later paper the feeding reactions and nematocysts of this and fifteen other species of corals are described. Valuable observations on tentacular and ciliary feeding are recorded, the general conclusions supporting those of Yonge[3] that corals are specialized carnivores feeding on zooplankton. Ecological studies revealed that this species is widely distributed in regions of still water on sandy areas where it is frequently aggregated in large numbers together. Abe analyses the causes of this distribution in a paper dealing with migration and righting actions. He confirms the observations of Marshall and Orr[4] that Fungia is capable of uncovering itself when buried under sand while he also reveals that it can right itself when turned over. This reaction, as well as uncovering, are due to expansion of the disk tissues high above the underlying skeleton. The same phenomenon has been recorded by Yonge[5] in *Maeandra areolata*, the unattached meandrine which occupies a similar habitat in the Atlantic. The aggregation of Fungia is explained by the action of tidal currents which carry them into areas of still water where sand collects between coral patches. Work on the biology of these unattached corals reveals the great powers of adaptation possessed by Madreporaria.

Abe also describes the expansion and contraction of the polyps of *Caulastræa furcata* which, like the great majority of reef-building corals, expands only by night. Expansion has no relation to food, zooplankton supplied by day failing to induce it. Abe associates expansion by night with the greater need for diffusion of carbon dioxide when this is not removed by the photosynthetic action of the zooxanthellæ. He found that expansion occurs by day when oxygen tension is low and that of carbon dioxide is high. But actually it is contraction during the daytime—a condition not found in the

other Anthozoa—which requires explanation, not expansion by night. Nevertheless Abe has broken new ground in this work which will contribute to the eventual solution of this problem.

In a series of papers on the physiology of reef corals Kawaguti confirms the observations of Yonge, Yonge and Nicholls[6] on the oxygen consumption of corals in relation to its production by the zooxanthellæ, and adds important data on the effect of light on pigmentation and growth. Upward growth of corals is all-important in the formation of reefs, and Kawaguti states that all reef-builders containing zooxanthellæ which he examined showed positive phototropism. The presence of glycogen, small amounts of a reducing sugar and copper in Fungia has been determined by Hosoi. Hayasi has entered the controversy concerning the mode of formation of the skeleton and decided that the calicoblasts are the ectodermal cells themselves, not specialized cells derived from these, which secrete the calcareous lamella, including the organic matrix, as an extracellular product. Other papers deal with animals associated with corals, and include observations by Hiro on the gall-crabs, Hapalocarcinus and Cryptochirus, and on cirripedes which grow on corals. A long paper by Matsuya is concerned with the hydrography and plankton of the waters of Iwayama Bay.

Enough has been said to reveal the range and interest of the work being carried out at the Palao Tropical Biological Station. The work of Prof. S. Hatai has long been known in connexion with his direction of the Asamushi Marine Biological Station and the numerous papers published by him and by his pupils in the Science Reports of the Tôhoku Imperial University. He is sincerely to be congratulated on the work of this new tropical marine station which he instituted and the activities of which he has since directed with such conspicuous success.

[1] "Zool. Mededeelingen", Leyden, **22** (1939).
[2] Sci. Rpt. G. Barrier Reef Exped., **3**, No. 8.
[3] Sci. Rpt. G. Barrier Reef Exped., **1**, Nos. 2 and 3.
[4] Sci. Rpt. G. Barrier Reef Exped., **1**, No. 5.
[5] *Pap. Tortugas Lab.*, **29**, 187 (1935).
[6] Sci. Rpt. G. Barrier Reef Exped., **1**, No. 8.

OBITUARIES

Prof. Ernest A. Gardner

THOUGH unable latterly to take active part in the studies to which he had contributed much, Prof. Ernest Gardner, who died on November 27, aged seventy-seven years, will be remembered in the University of London as the creator of a vigorous department of classical archæology, and as a stimulating teacher, as well as for his administrative services as Dean of the Faculty of Arts (1905–9 and 1913–15), and as Vice-chancellor in 1923–26. After a distinguished Cambridge career, he went out to Greece in 1886 with a fellowship of Gonville and Caius College, and a Craven Fellowship, as the first student of the newly founded British School of Archæology at Athens, of which he became director in the following year. He had already done a season's excavation at Naucratis with Flinders Petrie and Griffith, and took a leading part, with Montague James, Hogarth, and the present Rector of Lincoln College, in work at Paphos for the Cyprus Exploration Fund. Under his management, the British School soon took recognized place among other foreign institutes in Athens, and began to form the long series of explorers, excavators, and teachers at home, which has continued until the present time.

In 1896 the Yates professorship of archæology at University College, London, fell vacant, and gave Gardner a congenial opportunity. Here too he had to begin with the foundations, and secure for his subject a place in the curriculum. His best-known book, a "Handbook of Greek Sculpture", was published in the same year, and at once became the recognized English text-book: later it was supplemented by a more detailed study of "Six Greek Sculptors". In 1897 appeared his "Catalogue of Vases in the Fitzwilliam Museum", and in 1905 he supplemented the "Introduction to Greek Epigraphy" of E. S. Roberts, the Master of his own college, with a volume on the inscriptions of Attica. Of more general (and in the best sense popular) quality was his description of "Ancient Athens" (1902), published at a moment of pause after rapid and varied discoveries, when it was possible for one who knew the ground as Gardner did to present the results as a comprehensible whole, in the lucid style and with the fine scholarship which marked all his writing.

In the War of 1914–18, though over military age, Gardner put his intimate knowledge of Greece and the Greek people at the disposal of the Admiralty, and as a lieutenant-commander in the Royal Naval Volunteer Reserve, did valuable service at Salonica; in leisure moments bringing together at the White Tower the numerous antiquities found in the British trenches and within the lines. Of these the most conspicuous was a huge Roman milestone, whose inscription beginning *Kaisari Germanico* caused some mirth among the rank and file.

Returning to London, Gardner found many distractions in university affairs, but continued to publish useful books on ancient life and art in Greece, and to take an active part in the proceedings of the Hellenic Society, of the *Journal* of which he had been editor from 1897, while from 1929 until 1932 he was its president. A characteristic and memorable con-

tribution to classical studies was his series of cruises for students of all ages, undertaken when such facilities were rare and not easy to arrange; they brought him into personal contact with a wide variety of acquaintances, and opened what was then a new aspect of classical study. J. L. MYRES.

Prof. V. R. Williams

WE learn with deep regret of the death of Prof. Vasili Robertovich Williams, professor of soil studies in the Timiriazev Academy of Agriculture, and well known to soil investigators for his important contributions to agricultural science.

Williams was born in Moscow in 1863, the son of an American constructional engineer who had settled in Russia in 1854 and married a Russian lady. He studied at the old Petrovsky Academy of Agriculture and Forestry, to which after a period of postgraduate work in Paris with Pasteur, he returned as lecturer. In 1894 the Institute was replaced by the Agricultural Institute of Moscow and he was appointed assistant professor of soils and agriculture. In 1906 he became director of the Institute, and after the Revolution, when it was reorganized as the Timiriazeff Academy of Great Socialist Agriculture, he was again made director though afterwards a political head was chosen in accordance with the policy then prevailing.

From the outset, Williams's soil work centred around the organic constituents: he never lost his interest in these. Only last August he showed me a colourless crystalline organic substance which he had extracted from the soil and to which he attached great importance. Like other Russian soil workers after the Revolution, he did a good deal of soil surveying and he acquired an extensive knowledge of soil utilization and crop production in Russia. On the applied side his most important activity was his keen advocacy of grass leys in the rotation. Russian agriculture was, until recently, mainly based on variants of the old three field system, fallow, winter corn, spring corn. Williams knew how greatly the agriculture of Western Europe had improved when a clover or grass and clover crop was inserted between the corn crops, and he strenuously urged that this should be done in Russia. The coming of collectivization gave an opportunity for a change of system, and the need for increasing the animal population after the devastating losses of livestock at first incurred furnished the justification for strenuous efforts to ensure ample production of fodder crops. So Williams used all his great influence in the U.S.S.R. to extend the culture of grasses and clovers and showed that, not only would more cattle food be produced, but also the soil fertility would be increased and the danger of erosion lessened.

In his later years, Williams devoted much time to the building up of his soil museum, and on each of my recent visits to the Institute he personally demonstrated its chief features: it included a large number of typical profiles with specimens or illustrations of the flora native to each type, and charts showing the most suitable kind of agriculture.

His soil work is described in his book, "Soil Science", first published in 1914 and revised in 1920.

Williams was afflicted with a paralysis which impeded his activities but never damped his enthusiasm. Like others of the older school of Russian scientific workers, he had a good knowledge of a Western language so that conversation and discussion were always easy. In his case the language was English, learned from his father and never forgotten. His work was much appreciated in Russia and he was given the highest awards open to Soviet citizens: the Order of Lenin, a seat in the Supreme Soviet, and membership of the Academy of Sciences; more important still, the deep respect, softened by affection, of many past students now engaged in agricultural organization in Russia. One of the pavilions of the great agricultural exhibition at Moscow is adorned with a very large mural painting showing him at work in his department. E. JOHN RUSSELL.

Mr. G. Eumorfopoulos

WE regret to record the death at the age of seventy-six of Mr. George Eumorfopoulos, which took place on December 19. Eumorfopoulos had long been known as a great collector and skilled connoisseur of objects of Oriental art and more especially of the art of the Chinese.

George Eumorfopoulos was born in Liverpool in 1863. Until 1934 he was a member of the well-known firm of Ralli Bros. His career as a collector began with English and Continental porcelain, but he soon turned to Oriental art, and was one of the first collectors to give special attention to pieces of the earlier Chinese dynasties—Chou, Han, T'ang and Sung. In this field his collection for the beauty, rarity, and historic and archæological value of the specimens it contained, ranked among the greatest in the world. It was thrown open with the greatest liberality to students, fellow-collectors and connoisseurs from any and every part of the world without distinction beyond interest in that field, which Eumorfopoulos by the judicious use of his wealth in the service of his knowledge and his artistic judgment had made peculiarly his own.

Above everything Eumorfopoulos was anxious that so far as was possible others less fortunate than himself should share in the advantages for study that he enjoyed. A type collection of Chinese porcelain was formed by him and presented to the Museum at Athens, and his gifts to other museums were both numerous and valuable; but his greatest sacrifice was unquestionably the sale of his collection as a whole, which through his generosity in accepting a price far below its pecuniary value, became the property of the British nation in 1935. Now, though divided, it forms by far the most important part of the material available for the study and appreciation of the art of the Far East in the national collections.

Eumorfopoulos was also a generous supporter of all forms of archæological investigation, but more especially if it showed likelihood of advancing knowledge of the history of art. As Sir Leonard Woolley

has recalled, he was a generous contributor to the funds for the excavation of Ur; and a visit to the site of the excavation was one of the few occasions on which he travelled in the East. Another which afforded him an even greater delight than that he experienced in Mesopotamia was when in 1935 he travelled in China with R. L. Hobson of the British Museum to help in selecting exhibits for the International Exhibition of Chinese Art held in London in the following winter. The welcome he then received in China was such as befitted his eminence as a collector and expert, and was in a sense the crowning reward of his career.

WE regret to announce the following deaths:

Prof. Czeslav Białobrzeski, professor of theoretical physics in the University of Warsaw, recently executed by the German authorities in Poland, aged sixty years.

Sir John Withers, M.P., who has represented the University of Cambridge in Parliament since 1926, a former president of the Alpine Club and member of the Mount Everest Committee, on December 29, aged seventy-six years.

Prof. Hans Ziemann, professor of internal medicine in the University of Berlin, aged seventy-four years.

NEWS AND VIEWS

Seventy Years Ago

ON November 4, 1869, the first issue appeared of a new "weekly illustrated journal of science" entitled NATURE. It was under the able and forceful editorship of Sir Norman Lockyer, who secured the support of the leading men of science of the day for the new venture. Turning back in thought to those days, it will be seen that there is a certain parallelism between world affairs of that time and the present international situation. Prussia had defeated Austria and its German allies, and had emerged as a leading European power. Strategic railways had been built to the eastern and western frontiers, and tension between Germany and France increased until in July 1870 war was declared. The campaign was relatively short, but its consequences were momentous and have determined much of the history of the past half-century. It seemed worth while, therefore, to turn back to the early pages of NATURE, to note the reaction of scientific men and affairs to the course of events, and to observe the progress of science as recorded week by week in this journal. Let this be sufficient reason for the column of quotations and notes, taken from the first number of NATURE to appear in 1870, which is printed elsewhere in this issue (p. 41). It is proposed to publish week by week similar extracts from the issues of NATURE of "seventy years ago", in the hope that scientific workers will derive both profit and pleasure from these contemporary accounts of scientific thought and events.

Royal Meteorological Society: Symons Gold Medal

THE decision of the Council of the Royal Meteorological Society to award the Symons Gold Medal for 1940 to Dr. J. Bjerknes will be very popular among British meteorologists, to whom he has become well known during his frequent visits to this country. In 1932 the Medal was awarded to his father, Prof. V. Bjerknes, and it is fitting that the son, who shared the work, should also share the honours. Dr. J. Bjerknes is well known for his numerous and penetrating memoirs on the structure of barometric depressions and on the mechanism of the atmospheric circulation. Among his earlier papers we may mention "On the Structure of Moving Cyclones" (1919), and (with H. Solberg) "Meteorological Conditions for the Formation of Rain" (1921), and "The Life Cycle of Cyclones and the Polar Front Theory of Atmospheric Circulation" (1922) in which he laid down the principle of 'cyclone families' and emphasized the role taken by depressions as an integral part of the exchange of air between high and low latitudes.

Later, while temporarily on the staff of the British Meteorological Office, Dr. Bjerknes compiled "Practical Examples of Polar-Front Analysis over the British Isles in 1925–6", published as Geophysical Memoir No. 50, and he has since analysed in great detail, on the bases of both surface and upper air observations, a number of depressions presenting special features. In 1933 the accumulated research of the Norwegian school of meteorologists into the dynamics of the atmosphere was published in book form under the title "Physikalische Hydrodynamik" by V. and J. Bjerknes, H. Solberg and T. Bergeron. Dr. Bjerknes is still young, and we look forward to further important research in future from these brilliant Norwegians.

University of Oxford: Chair of Forestry

MR. H. G. CHAMPION has recently been appointed to fill the chair of forestry at Oxford in succession to the late Prof. R. S. Troup. Mr. Champion graduated at Oxford with first-class honours in chemistry and botany. He went out to India in the Forest Service in 1915 and was posted to the United Provinces. After successful work in divisional and working plans posts he was selected for appointment as sylviculturist at the Forestry Institute at Dehra Dun. In this post he carried out some notable work. Perhaps Mr. Champion's most important contributions to sylvicultural research in India and Burma were a "Sylvicultural Research Manual for India", in two volumes—"The Experimental Manual" and "The Statistical Code"—and a "Preliminary Survey of the Forest Types in India and Burma".

The opening paragraph of the "Research Manual" is testimony to Mr. Champion's methods—"Research work ought never to be hampered by compulsory adherence to any prescribed methods of investigation or of recording. This does not, however, prevent the research worker from receiving considerable aid from the results of his own experience and that of others". This dictum he illustrated in his "Problem of the Pure Teak Plantation", which included valuable notes supplied by the Forest Research Institute of the Dutch East Indies. Other monographs published were notes on *Pinus longifolia*; contributions towards a knowledge of twisted fibre in trees; the importance of the origin of seed used in forestry; rejuvenation and management of sal (*Shorea robusta*); and a "Manual of Indian Sylviculture" (with Sir Gerald Trevor). In addition to visiting all parts of India and Burma as sylviculturist, Mr. Champion was asked by the Government to advise on the management of the Ceylon forests. He visited North America, Japan and Malaya to study local forest soil conservation problems, and saw something of the Kenya forests on his way home on leave in 1939.

Prof. W. P. Jorissen

THE Netherlands Chemical Society announced on December 23 that Prof. W. P. Jorissen is retiring from the editorship of the *Chemisch Weekblad* after serving that journal for thirty years. Although Holland is a small country, it has for many centuries been to the fore in the advancement of science, and Prof. Jorissen, who celebrated his seventieth birthday on November 11, 1939, will rank as one of the country's most distinguished chemists. Since his first paper in 1894 dealing with the oxidation of phosphorus, he and his collaborators have contributed many papers from the laboratory for physical chemistry at the University of Leyden. The most important of these deal with his detailed study of the regions of reactions among gases, and even among solids, and with the physical chemistry of explosions (notably the limits). In addition to his academic and research activities at Leyden, Prof. Jorissen, who is an excellent linguist, was editor-in-chief of the *Recueil des travaux chimiques des Pays-Bas* as well as of the *Chemisch Weekblad*. This brought him into lasting contact with the many British chemists who have had occasion to contribute to this Netherlands monthly journal, which publishes communications in French, German and English. We join with his Netherlands colleagues in wishing Prof. Jorissen a long and happy retirement.

Parliamentary and Scientific Committee: New Chairman

AT the last general meeting of the Parliamentary and Scientific Committee at the House of Commons, Captain L. F. Plugge, M.P., was unanimously elected chairman. Captain Plugge is a science graduate of the University of London and also of the University of Brussels. During the War of 1914–18, when serving with the Royal Naval Air Service, he was the Admiralty representative at the National Physical Laboratory at Teddington. He also served on the directorate of Aeronautical Research at the Air Ministry under Sir Robert Brooke-Popham, when he evolved in collaboration with Dr. Thurston the design of the first military aeroplane constructed entirely in metal to be built in Great Britain. He has been a fellow of the Royal Aeronautical Society since 1923, and was responsible for the Society's glossary of aeronautical terms (French translation). His work on wireless, which has covered the last fifteen years, is well known, and he is an authority on matters relating to broadcasting.

The University of Cracow

EXPRESSIONS of sympathy have been received by the Polish Ambassador in Great Britain from universities in Great Britain, the Association of University Teachers and the Universities Bureau of the British Empire in reply to a statement concerning German activities in connexion with the University of Cracow (*The Times*, Dec. 22). It appears that the members of the teaching staff of the University were invited to attend a conference at which the German attitude toward Polish men of learning was to be explained. The tone of the address offended the audience, who walked out, to find lorries waiting outside, in which they were removed and sent eventually to a concentration camp in Germany.

It is stated that 160 members of the University are involved, including Prof. Kazimierz Kostanecki, a former president of the Polish Academy of Sciences, and Adam Krzyzanowski, a distinguished economist, who has since died. A message from the University of Leeds contains the following passage: "The members of the Senate of the University of Leeds . . . desire to place on record their strong condemnation of an action which can have no military justification and must be regarded as part of a deliberate and wanton attempt to destroy the culture and learning of the Polish peoples." We are sure that readers of NATURE will be in hearty support of this view.

The University of Birmingham

THE University of Birmingham has settled down to war conditions more smoothly than was anticipated, thanks largely to the recruiting policy of the Government whereby some of the deplorable errors of the War of 1914–18 in the waste of ability of university students have been avoided. The number of students in some departments has actually increased, and in the department of medicine in particular the number of full-time freshmen has reached a total of forty-four more than that of last year. The Nuffield Physics Extension Block is nearly ready for occupation, but the exigencies of war-time have unfortunately interrupted the building of Prof. Oliphant's large cyclotron, which is to be the chief feature of the new block.

The new gymnasium of the University also is nearly complete, and it is hoped that it will be used in the near future for physical training. The plans for extension of the Students' Union have had

to be dropped for the present. Extra-mural work under the Joint Committee of the University and the Workers' Educational Association has made progress and the number of classes and students has increased. Prof. W. K. Hancock has been given leave of absence to visit West Africa for a study of West African problems in continuance of his "Survey of British Commonwealth Affairs". Dr. O. Frisch of Copenhagen has been appointed a temporary member of the staff of the Physics Department.

Social Services for Youth

THE Board of Education has directed attention to a serious deficiency in our social services in a circular recently issued to the local education authorities for higher education in England and Wales, and a similar circular has been issued by the Secretary of State for Scotland to the education authorities in Scotland. These authorities are asked to take steps to set up local youth committees in their areas, and voluntary organizations and education authorities are called upon to combine in making real provision for the social and physical development of young persons between the ages of fourteen and twenty who have ceased full-time attendance at school. This neglected and elusive problem has been accentuated by war conditions—the black-out, the strain and disorganization of family life—and the Board of Education has now assumed a direct responsibility for juvenile welfare. The National Youth Committee has been appointed to advise them and a special branch of the Board of Education office has been organized to deal with grants and other administrative duties.

The new committees will place youth work on an equal basis with the rest of education. Sometimes they will be sub-committees of local authorities; others may represent all local interests including the local authority. Their task will be to work out an ordered policy, meeting both the immediate needs and indicating the lines of advance under more favourable conditions. Local education authorities are expected to see that the Committee is properly staffed and equipped with office accommodation, and they can assist financially by making grants towards the rent of buildings, salaries of full-time leaders, upkeep and maintenance of premises, including provision of equipment and instructors. The appointment of the National Youth Committee has been welcomed by the King in a message to the Prime Minister, in which His Majesty appeals to the public for volunteers to undertake the tasks of leadership and organization which these plans envisage, and an announcement asking for volunteers has already been made by the President of the Board of Education and the Secretary of State for Scotland at the request of the National Youth Committee.

American Psychologists in War-time

AMERICA believes in being forearmed. Already the American Association for Applied Psychology has devised a plan to mobilize psychologists to aid the Government in time of emergency as they did in 1918 (Science Service, Washington, D.C.). The chief problems to be considered are connected with the selecting and classifying of men according to their abilities, the selecting of promising recruits for military flying, treating those who break down under the strain of war and discipline, and keeping up the morale of armed forces and those at home. The human element and human 'nerves' are much more important now than in the War of 1914–18, although even then a considerable proportion of war casualties were 'nervous' cases.

At the meeting which discussed the matter there were representatives of the Army and Navy, the Public Health Service, and the Department of Justice. The armed services have already arranged to avoid in any future war the heavy psychological casualties of the last war. The first step has been to provide for the careful psychiatric examination of all new recruits, with an observation period in which any border-line cases might be weeded out or assigned to jobs where personality difficulties will be at a minimum. They are also discussing whether, by means parallel to those used by enemy agents to foment discord, psychologists could be used to promote good feeling and smooth out grievances.

Aquaria Societies' Difficulties

THE wartime difficulties of aquaria societies, especially those which maintain public aquaria, have not proved so disastrous as at first expected. The Scottish Aquarium Society, at a recent meeting, decided to produce a modified edition of its journal *Scottish Aquarium Herald*, as Mr. R. Kerr, the original editor, is serving in H.M. Navy. Brighton Aquarium recently acquired an attractive exhibit of 120 silver whiting (*Gadus merl angus*), as well as congers, anglers, spider crabs, ocean sunfish and an owl fish. The Carnegie Aquarium at Edinburgh is also managing to keep a full stock of exhibits, including herring. Manchester Zoo Aquarium has 41 specimens of *Neon tetra* on view in the tropical section, as well as a large electric eel. Dudley (Worcestershire) Zoo Aquarium recently received some claw-footed toads.

On the Continent, Paris Zoo Aquarium has distributed its fish to the Prince of Monaco's Aquarium at Monte Carlo and to private individuals, and its reptiles to Marseilles Zoo. The aquarium at Berlin Zoo has been broken up and closed and the reptiles destroyed. Hamburg Zoo has disposed of all its collection. Belle Vue (Manchester) Aquarium and Vivarium Society has decided to levy half the normal subscription and review the position again in six months' time.

Archæological Discoveries of 1939 in Ireland

ARCHÆOLOGICAL excavations in the vicinity of Lough Gur, Co. Limerick, in the season 1939, it is claimed in a report in *The Times* of January 2, have obtained results of outstanding significance for Irish archæology. This area has now been under investigation for four consecutive seasons, thanks to the Government's scheme for the relief of unemployment;

and several sites have been examined, including three stone circles, a megalithic tomb, and a series of dwelling sites. The excavations have been carried out under the direction of Prof. Seán P. O'Riordain of the University of Cork. The principal site excavated in 1939 was a large and exceedingly well-preserved stone circle on the western side of the lake, near the Bruff-Limerick road. Not only is this the best known prehistoric monument of the Lough Gur, but it is also said to be the finest stone circle in Ireland. It is built of large stones backed up by a huge bank of earth, and encloses a level, open internal space 155 ft. in diameter.

Here important finds of pottery were made, of which some afford evidence for a new chapter in Irish archæology. A reconstructed vessel proved to be a 'beaker', the first of its kind to be found in Ireland. It belongs to the class of ceramic characteristic of the 'Beaker Folk', who reached Britain in the late neolithic or Early Bronze ages, but, it has been thought hitherto, did not reach Ireland. A further discovery of considerable interest is that of neolithic pottery of types found only sporadically in Ireland, except in the north-east. On the evidence of the finds, the circle is dated at approximately 1700 B.C., and its ritual purpose, that of a prehistoric temple, is regarded as definitely determined. In a group of neolithic houses on the peninsula of Knockadoon in Lough Gur, one, exceptionally well-constructed, is said to be the earliest house yet found in Ireland. It is 32 ft. long by 18 ft. wide. The lower part of the walls is of stone, the superstructure of wood and thatch—a type well known from various periods in northern Europe.

Landscape Meteorology

MR. L. C. W. BONACINA's paper entitled "Landscape Meteorology and its Reflection in Art and Literature" (*Quart. J. Roy. Meteor. Soc.*, **65**, No. 282; October 1939) is a detailed study of the scenic aspect of clouds and weather, and an example of that co-operation between science and art which is one of the most interesting developments of culture during recent years. We welcome particularly the author's dictum that it is a mistake for the man of science to regard scenic values as altogether outside his province. It is equally to the point that the landscape artist will find additional enjoyment, and possibly also increased efficiency, if he studies the physics of meteorological effects. The later part of the paper is mainly devoted to descriptions of local and seasonal phenomena. One outstanding example is that of the night sky as seen from the high plateau of Bolivia, where the general aspect of the constellations is that of coloured stars.

Valuable as is this elaborate paper, the reader cannot help feeling how great is the difficulty of bringing the artistic and scientific aspects of a subject into one essay. The perceptive and reflective moods are alternate, and the literary technique for their simultaneous treatment has not been fully mastered. Indeed, we do not yet know if it can be mastered. If so, it will be by Ruskin re-incarnate in the world of to-day, with the same faculties of sight and expression but imbued with the culture of the present time.

Malnutrition in South Africa

AN informative survey of the state of nutrition of the peoples of South Africa is given by Ellen Radloff and T. W. B. Osborn in a pamphlet with the above title (Johannesburg: The Witwatersrand University Press, 1939. 2*s*.). South Africa has been spoken of as the most prosperous country in the world, which is a true statement for a minority of the European section. But South Africa is also a country of poor whites and poorer blacks, which is true for several millions of non-Europeans and several hundred thousands of Europeans. The principal dietary essentials for proper nutrition are discussed, with descriptions of the conditions that result when these are deficient. Tables are given of the vitamin content of common foodstuffs and of typical South African diets.

The basic ration scale recommended for adult Europeans at the Health Department's institutions appears to be ample and adequate, and is in striking contrast to the daily diet scale for adult native paupers in Cape Province, which consists of 1 oz. of fat (not butter) and 24 oz. of mealies. Remedies are suggested for the malnutrition that exists, which include improvement of the economic condition of the people, educating them to buy meat, milk, fruit and vegetables, and in rural communities providing more land for them to buy and improving their grade of cattle. A direct pharmacological approach to the question is also suggested by providing rations of essential salts and vitamins.

Underground—and the City of the Future

IN the *Beama* journal of November reference is made to Le Corbusier's city of the future consisting of dwellings, offices, and factories contained in huge blocks separated by gardens. One of the main features of this modern city is the large part of its activity which takes place underground. Power stations, garages, warehouses and other public service buildings, as well as traffic routes for vehicles and pedestrians, would be constructed in this way. Already there exists a plan for the diversion of a large part of the Paris traffic, the underground routes for which were examined by the Minister of Public Works some years ago. *Électricité* published a report on this subject by M. Roger d'Arboville, professor of applied electricity in the well-known École spéciale d'Architecture, on the lighting of underground traffic and pedestrian routes. He reviews the practice exemplified in some of the short subways in Paris, in the long road tunnel projected for 1941 under the Meuse, the mile-long roadway under the Escaut at Antwerp and various railway tunnels in France and England.

M. d'Arboville discusses the question of the lighting of underground road tunnels both in actual road tunnels and in many tunnels which are projected. The ever-increasing density and speed of

road traffic make this question of great importance, especially at the entrances to the tunnels. The light conditions at these places must be very carefully graded or else the speed of all transport entering the tunnel must be heavily stepped down. The latter course is objectionable as it interferes with the normal flow over a wide area. He suggests that photo-electric cells might be used to maintain the lighting more constant and so overcome the changing variations of natural light. The photo-cells should be directed towards the ground, since otherwise the effect of sunlight variations is too strong.

Dismantling an Old Colliery

WE learn from an article in *Roads and Road Construction* of December 1 that the famous Cymmer Colliery at Porth, Glam., from which coal has been raised for more than a hundred years, has recently ceased work. The immense quantity of plant which it contains is to be dismantled and made available for use either in the coal industry or in similar industries engaged on contracts of national importance. In the history of this colliery, which once employed more than three thousand men and produced more than three thousand tons of coal a day, an interesting story is told of how about fifty years ago, whilst boring in the shaft for piping supports, the men struck what is called a 'gas blower', which is a sort of pocket of free gas. In these days men were permitted to take naked lights down in the cage with them so that they could heat their tea, and one of these lights ignited the natural gas. As it was dangerous to allow such gas to escape into the shaft, a two-inch pipe was installed to conduct it to the surface. Here it has been burning for fifty years without being extinguished. Measurements show that approximately 650 cub. ft. per hour was being emitted at the 'blow'. The gas is chiefly methane, and arrangements have now been made to 'bottle' it in steel cylinders at about 800 lb. per sq. in. pressure for scientific and industrial use.

Messrs. George Cohen of London and Swansea are at the present time running a 5,000 cub. ft. vertical engine-driven compressor now in the mine to supply air to the haulages for removing the underground plant and machinery, of which there is no less than 4,000 tons, including about 1,200 tons of pit rails. Compressed air was also supplied below for working coal-cutters, jigger conveyors, belt conveyors, and turbine fans. Electric light, both for underground and surface, is supplied by steam-driven generating sets. In 1933 a modern dry coal cleaning plant of 75 tons per hour capacity was installed at a cost of about £20,000 by the Birtley Iron Co. The roads to the pit are in excellent condition, being supported by about 1,700 tons of steel arches, of which Messrs. Cohen expect to recover about 500 tons.

Hydro-Electric Development in India

RECENT reports from India, referred to in *Beama* of November, state that a very large irrigation scheme which will include the generation of large quantities of electric power between the Punjab and the State of Bilaspur is under construction. The volume of water that will be impounded is three times as large as that of the Aswan dam across the Nile. A further scheme for the development of water power utilizes the high run-off of the monsoon rains from the High Range Hills to the plain at Travancore in southern India. Power is obtained from the Munnar River as it descends in a series of cascades from the hills. The monsoon waters are impounded in storage reservoirs built on natural sites. The power station is built on the banks of the river, with the tail-race planned to discharge into it. Above stream, the river water is decanted by a weir, then passes through a channel to the tunnel and forebay. From there it is carried in a 10,000 ft. long tunnel—an open channel was impracticable owing to the crumbling nature of the surface rock—to the surge tower. Two parallel pipe-lines connect with the power house, each supplying water to a 6,000 brake horse-power turbine.

Weather by Telephone in New York

ACCORDING to the *Bell Laboratories Record* of November, the New York Telephone Co. inaugurated a new service last April. It is now possible in the Metropolitan area to dial 'weather', and hear the latest weather prediction, including the anticipated temperature, winds, and rain or snow conditions. The bulletins are based on direct teletype reports from the United States Weather Bureau; at present these reports are changed hourly between seven in the morning and eleven at night. When important changes occur, special bulletins may also be given. All the equipment used for this service is installed in the West Fiftieth Street Central Office building, and weather announcing trunk lines are run to all the central offices in Manhattan, while other parts of the metropolitan area reach the announcing bureau through subcentres or tandem offices. In the time-announcing system a special operator makes each announcement herself. In the weather system use is made of a recorder using magnetic tape. It is well suited for this service as it is necessary to change the recorded message frequently and permanent preservation of the record is of no importance.

The record is made in the usual way by producing, in a moving steel tape, a magnetic pattern corresponding to the voice current coming from the microphone circuit. This pattern remains in the tape and can be 'picked up' electrically many thousands of times before being erased. This is done by saturating the tape with a strong magnetic field. The entire process of erasing, recording a new message and reproducing is controlled by a few keys in the operating turret. No experience or technique is required to obtain exact reproduction of the announcement, and since the steel tape can be used again and again indefinitely, there is no continuing expense for record material and no processing cost involved. Three of these machines are used. The tape machine employs slightly more than 40 ft. of tape wound on three brass drums. The two ends of the tape are electrically welded so that it forms a single tape loop.

Demography of Canada

ACCORDING to the report recently made to the International Office of Public Health (*Bull. Off. internat. d'hyg. publ.*, **31**, 1678; 1939) by Dr. H. B. Jeffs, the delegate for Canada, the population of Canada, exclusive of Yukon and the North Western Territories, amounted to about 11,106,000 on June 1, 1937. The marriage-rate for 1937 was 7·9 per 1,000 inhabitants. The highest percentage of marriages was registered in Manitoba (8·5) and the lowest in Saskatchewan (6·2). The birth-rate was 19·8 per 1,000 inhabitants as compared with 20·0 in 1936. The total number of live births was 219,988 in 1937, as compared with 220,371 in the previous year. The highest birth-rate was in the province of Quebec, where 75,635 births were registered or a rate of 24·1 per thousand inhabitants. In 1937, 113,694 deaths were registered in Canada or a mortality of 10·2 per 1,000 inhabitants, as compared with 9·7 in 1936. The total number of deaths of children under one year of age was 16,675 or a mortality of 76 per 1,000 live births as compared with 66 in 1936. The maternal mortality was 1,067 in 1937 or a mortality of 4·9 per 1,000 live births, as compared with 1,233 deaths or a rate of 5·6 in 1936. The highest maternal mortality was in Prince Edward Island (5·8 per 1,000 live births) and the lowest in Nova Scotia (2·7 per 1,000 live births).

A New Biological Journal

UNDER the title of *Lloydia* the Lloyd Library of Natural History, Cincinnati, Ohio, has commenced the publication of a new quarterly journal of which the first number appeared as Vol. 1, Nos. 1–4, 1938; the date of publication is given as January 7, 1939, but a copy has only just reached NATURE. The subscription rate is three dollars per annum. The editor is Theodor Just. From the numbers already published, the main field of the new journal would seem to be systematic, but papers dealing mainly with structure have been published and many of the communications have been freely illustrated with both drawings and photographs. Manuscript contributions are welcomed, as also exchanges with other institutions. Communications should be addressed to the Librarian, Lloyd Library, 309 W. Court Street, Cincinnati, Ohio.

Bibliography of Seismology

THE *Bibliography of Seismology*, **13**, No. 2, published by the Dominion Observatory at Ottawa, has just been received. It contains 124 items over the period April, May, June 1939, and has been compiled with the assistance of collaborators in Canada, United States, New Zealand, Italy, Germany, Norway, Japan, U.S.S.R., France, Holland and England. As in the preceding number, in addition to works on pure seismology, there is again a considerable number of works listed on applied seismology, chiefly concerned with geophysical prospecting. A list of patents concerned with this latter contains eight items, five being United States patents, one Canadian, and two U.S.S.R. It is pleasing to see a considerable number of papers listed from the Seismological Institute, Academy of Sciences, U.S.S.R., though it would add to the value of these Russian works if the authors supplied translations or abstracts in French, German or English. Unfortunately, again South America is not represented.

Earthquake in Central America

AN earthquake of considerable intensity was experienced on the Pacific coast of central America on December 5 just after 8.30 G.M.T., though no damage has been reported. The shock was recorded on practically all the seismographs in America; at De Bilt (Holland), where the preliminary waves arrived just after 8.42; and at Kew, where a full complement of waves including P_cP, *SKS* and *SSS* were readily discernible. The maximum ground displacement at Kew was 0·043 mm. From readings of seismograms at adjacent stations, the epicentre has been determined by the United States Coast and Geodetic Survey to have been in the Pacific Ocean some twenty miles due east of Rio Suchiate (Guatemala).

Announcements

THE U.S.S.R. Academy of Sciences has marked the sixtieth birthday of M. Joseph Stalin by electing him an honorary member of the Academy, nominally in recognition of his contributions to the development of the social theories of Marx and Lenin. It should be noted that even the ordinary membership of the Academy is restricted to a limited number of men of science of outstanding repute, while there are very few honorary members, all of them hitherto being scientific men of international fame.

PROF. FRITZ LEJEUNE, of Cologne, has been appointed professor of the history of medicine and director of the Institute of the History of Medicine at Vienna.

THE Italian Minister of the Interior has offered a prize of 30,000 lire for the discovery of chemical or biological substances to take the place of insulin.

THE League of Nations Health Committee has arranged to set up a sub-committee which may be summoned in an emergency to deal with epidemics of infectious diseases arising out of the War.

THE Ministry of Health has published a memorandum on typhoid fever for the use of local authorities and medical officers of health (Memo. 225/Med. H.M. Stationery Office. 2*d*. net). The memorandum deals with typhoid and paratyphoid fevers, their history, diagnosis, prevention and control, and it contains an appendix on laboratory methods of diagnosis.

LETTERS TO THE EDITORS

The Editors do not hold themselves responsible for opinions expressed by their correspondents. They cannot undertake to return, or to correspond with the writers of, rejected manuscripts intended for this or any other part of NATURE. *No notice is taken of anonymous communications.*

IN THE PRESENT CIRCUMSTANCES, PROOFS OF "LETTERS" WILL NOT BE SUBMITTED TO CORRESPONDENTS OUTSIDE GREAT BRITAIN.

NOTES ON POINTS IN SOME OF THIS WEEK'S LETTERS APPEAR ON P. 32. CORRESPONDENTS ARE INVITED TO ATTACH SIMILAR SUMMARIES TO THEIR COMMUNICATIONS.

A Factor influencing Nitrogen Excretion from Leguminous Root Nodules

THE excretion of nitrogen compounds from leguminous root nodules which has been demonstrated in this laboratory with a sterile culture system and, from the practical point of view, investigated with ordinary pot cultures, has not been shown in the pot cultures of all investigators[1,2]. With a sterile culture system Wilson has accomplished the excretion almost regularly[3].

It is difficult for us to explain the negative results appearing in the literature since, during 1928–38, we have regularly obtained excretion, and often a very powerful one, in hundreds of experiments also with pot cultures. In 1938 and 1939, however, excretion occurred only in a part of the experiments. Of parallel cultures under the same conditions, some showed powerful excretion while little or no excretion occurred in others. Light intensity could therefore not be the cause of conflicting results, as the plants were growing under identical conditions. There was also no difference in the quality of the quartz sand used in them.

In trying to discover the cause of these variations we finally paid attention to the quality of the containers. We have always used unglazed pots of burned clay. When we examined the pots used in the summers of 1938 and 1939 we noted great variations in their porosity. The pots in which oats grew fairly well in association with inoculated peas proved to be more porous than those where the growth of the oats was poor. The porosity of the pots was measured by allowing them to soak in water and determining the time which was required to make the inside of the pot moist. The accompanying table illustrates some of our results.

Unglazed burned clay pots, diam. 9 in., 7·75 kgm. quartz sand, 4 peas (inoculated with bacterial strain *H X*) and 6 oats (Guldregn II) in each pot. Control: 6 oats alone. N-free nutrient solution. Period of growth: 20 July–25 Sept. 1939. 3 parallel experiments.

Variety of pea	N in peas, mgm.	N in oats, mgm.	Excreted N taken up by oat, mgm.	Soaking time of the pot, min.
Adoptive	172·2	69·6	55·2	33
	100·8	40·9	26·1	31
	187·6	24·1	9·3	105
Concordia	204·3	48·2	33·4	20
	439·9	13·4	− 1·4	80
	247·6	32·5	17·7	25
Marmor. Glæno	167·8	74·2	59·4	45
	546·1	17·9	3·1	165
	616·9	13·4	− 1·4	160
Control		15·4 14·8 14·3 } 14·8		

Our results show that the growth of oats in associated culture with pea depends evidently on the porosity of the culture pot, and thus on the aeration of the media. As the experimental conditions—sand and nutrient solution—have been identical in all experiments, only the difference in the quality of the pots can explain the decided variations in the excretion of the parallel cultures. The experimental data also illustrate the fact noted earlier that when the excretion is high the growth of the pea is often, though not always, impaired.

When the excretion of nitrogen from the leguminous root nodules is investigated in associated cultures with ordinary pot cultures, containers should be clay pots, which are very porous. Large pots generally give better results than small ones.

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[1] Bond, NATURE, **140**, 683 (1937).
[2] Wilson, NATURE, **140**, 154 (1937).
[3] Wilson, *J. Agric. Sci.*, **27**, 307 (1938).

Effects of Concentrated Aqueous and certain Non-aqueous Solutions of Alkali upon Wool

CHEMISTS are well aware that wool is readily attacked by alkaline reagents. These disrupt the disulphide groups of the cystine contained in the polypeptide chains, thus weakening the fibre structure. The woollen manufacturer also recognizes that wool is susceptible to attack by alkali, as the term 'alkali damage' indicates. This damage frequently results from inefficient scouring which afterwards causes the wool to dye unevenly.

The surprising fact that the fibre is not seriously damaged by cold, concentrated, aqueous solutions of sodium hydroxide was investigated by Buntrock[1], Matthews[2], and Speakman[3]. The two earlier workers showed that yarns, treated with 52 per cent aqueous sodium hydroxide solutions, became stronger. Matthews reported that the sulphur content was greatly lowered by the treatment, that the surface

scales of the individual fibres fused together, that the ability of the wool to felt was not reduced, and that its affinity for acid dyes was increased. Speakman showed that the strength of individual fibres was unaffected by this treatment. He suggested that the increased strength of yarns was due to the fusing together of different fibres under the influence of weakly alkaline solutions formed during the processes involved in the removal of the alkali from the wool. Some of these matters have been reinvestigated by us, and particular attention has been given to the removal of the alkali in such a way that risk of damage to the fibres in this process was minimized. A summary of our results follows.

(1) The sulphur and nitrogen contents of merino wools are very little altered by immersion in 52 per cent sodium hydroxide for periods up to 30 minutes at room temperatures.

(2) No major changes in the surface structure of the fibre result from such a treatment for 5–10 minutes. Microscopic examination shows little or no difference between treated and untreated fibres.

(3) Wool treated with concentrated solutions of sodium hydroxide absorbs acid dyes *evenly*. Such wools have a greater affinity for acid dyes than similar untreated wools.

(4) A woven woollen fabric treated with 52 per cent sodium hydroxide shows less tendency to shrink on washing than a normal fabric.

These studies have been extended to the treatment of wool with alkalis dissolved in certain organic solvents. By using much weaker alcoholic solutions of sodium (or potassium) hydroxide, similar results to those obtained with concentrated aqueous solutions can be obtained with less risk of damage to the wool. The reduced tendency of treated wools to shrink, moreover, is much more marked, especially when knitted fabrics are used. This has been found to depend on:

(*a*) The nature of the alkali used. Potassium hydroxide gives slightly better and more even results than sodium hydroxide.

(*b*) The nature of the solvent. Solutions of alkali in dry methyl alcohol give less satisfactory results than similar solutions in alcohols of higher molecular weight.

(*c*) The percentage of water present in the solvent. The results are obtained slowly with dry reagents and quickly if 10 per cent or more of water is present. Damage to the fibre is more likely at these higher concentrations, and the optimum water content for speed of reaction, ease of control and minimum risk of damage is about 5 per cent.

The time of reaction depends on the concentration of the alkali used; thus we have found that with more dilute solutions longer immersion periods are required to give satisfactory results.

The limits that have been found with 7 per cent potassium hydroxide solutions are 1–30 minutes, depending on the water content of the alcohol used, and the treatment period may be extended to 16 hours with similar solutions of 0·05 per cent concentration. The rate of action increases with temperature.

Risk of damage to fibres after they have been treated with alcoholic solutions of alkali is eliminated by neutralizing excess alkali in a bath of 5 per cent, by volume, concentrated commercial sulphuric acid in alcohol. If hydrogen sulphide is evolved during the treatment it indicates that the process has been carried out incorrectly, and the wool will probably be damaged.

As regards strength and ability to stretch, treated fibres are not different from untreated. Their surface, however, is rougher than that of untreated fibres. These physical tests have been made by our colleague, Mr. E. H. Mercer, who has also noted that the more tightly twisted yarns of treated fibres are stronger than similar yarns of normal wool.

This method of treating wool promises to be of importance from both the commercial and the purely scientific points of view. Commercially, a treatment of wool for less than two minutes may give a product which is substantially non-felting, which absorbs dyes more readily, which can be made into stronger yarns, which will wear more satisfactorily than normal wool, and which shows less tendency to develop a fluffy surface during wear. Scientifically, the reagents may prove useful in further study of (*a*) the capacity of wool to combine with alkali; (*b*) the cause of felting and shrinkage resulting from this; and (*c*) the molecular structure of wool.

A full account of our work will be published shortly as a bulletin of the Council for Scientific and Industrial Research. The work has been facilitated by financial assistance granted by the Australian Wool Board.

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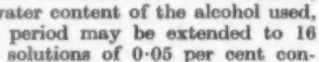
[1] Buntrock, *Farber Z.*, **9**, 169 (1898).
[2] Matthews, *J. Soc. Chem. Ind.*, **21**, 185 (1902).
[3] Speakman, *J. Soc. Chem. Ind.*, **118**, 321 (1929).

Amine Oxidase and Benzedrine

EXPERIMENTS which we have carried out during recent years seem to be of general interest in connexion with the observation reported by Mann and Quastel[1] on the effect of benzedrine (β-phenyl*iso*propylamine) on the metabolism of the central nervous system. First, it now seems possible to relate the action of the drug to an *in vitro* effect on one of the enzymic systems in the body; secondly, we can in this instance relate the action of the drug to its chemical structure. The effect on metabolism finds its explanation in the inhibitor action of β-phenyl-*iso*propylamine and its derivatives on amine oxidase. This effect was first described for ephedrine[2], but it was shown soon afterwards that ephedrine shared it with all other derivatives of β-phenyl*iso*propylamine that were examined[3]. The general rule emerged from these experiments that substances of the constitution



act as inhibitors of the enzyme. The characteristic difference between substrates and inhibitors of amine oxidase is that the latter contain the amino group not attached to a terminal carbon atom of a chain. It is known that the awakening effect of these drugs is also bound up with this characteristic structure, and that it is absent from those substances in which the amino group is attached to a terminal C atom of a chain[4,5]

Partly through the kindness of Dr. G. A. Alles, of Los Angeles, I have recently had the opportunity of examining a number of different amines of this group and have shown that a further subdivision of the β-phenyl*iso*propylamine group of inhibitors is possible. Substances of the structure $R—CH_2—CH.NH_2—CH_3$, for example, veritol and benzedrine, are much stronger inhibitors of amine oxidase than those of the structure $R—CHOH—CH.NH_2—CH_3$, for example, ephedrine; a comparison with the awakening properties of these substances in the living animal shows that there is again agreement between *in vitro* effect and pharmacological action[1*].

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* These experiments were carried out with a grant from the Ella Sachs Plotz Foundation.

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Electrophoresis of Animal Viruses and their Neutralizing Antibodies in Low Concentrations

A PERUSAL of the literature dealing with the physico-chemical properties of animal viruses and their neutralizing antibodies reveals the fact that very little attention has been given to the mobility in an electric field of these important substances.

The main investigations on the electrophoresis of viruses and their neutralizing antibodies have been to determine the sign of the charge and the direction of mobility[1,2,3], the separation of virus from virus-antibody mixtures[4,5], and the recovery of virus from the brains and spleens of animals recovered from virus diseases[5].

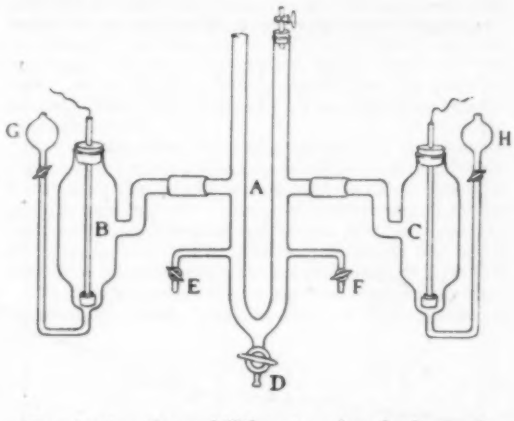
In none of the above-mentioned investigations has any attempt been made to determine the rate of migration of the viruses or their neutralizing antibodies, as the apparatus employed was highly unsuitable for that purpose. In order to measure the migration of viruses and their neutralizing antibodies an apparatus was constructed which has been applied with success to such measurements.

With the aid of the accompanying diagram the essential parts of the apparatus can be explained. *B* and *C* are two electrode vessels connected up to the U-tube *A* in the way illustrated. Two reversible silver–silver-chloride electrodes in saturated potassium chloride solution serve as anode and cathode. The electrode vessels and U-tube are filled with buffer against which the substance has previously been dialysed. By means of the two vessels *G* and *H* saturated potassium chloride solution is let into the electrode vessels to cover the electrodes. The virus or antibody in serum buffer mixture is let through the tap *D* to form a boundary under the buffer solution in *A*. The boundaries are brought up to levels above the two taps *E* and *F*. A position is marked off 2 cm. above the boundaries between the buffer and serum buffer mixture, and the electric current switched on. At the position 2 cm. from the original boundary small samples of fluid (0·1 c.c.) are carefully pipetted off with a fine pipette after suitable time intervals and tested by means of biological methods for virus or antibodies. The limb of the U-tube in which the samples are not taken is kept closed by means of a stopcock. The samples remain negative until the virus or antibodies reach the pipette.

The mobility of the substance investigated is given by the equation[6]

$$\mu = D\,x\,O/tA,$$

where D is the distance traversed by the substance (here 2 cm.); x is the conductivity of the solution; O is the cross-section of the U-tube at the point where the samples are taken; t is the time required for the substance to traverse the distance D; A is the strength of the electric current.



By plotting the mobilities at various hydrogen ion concentrations against the hydrogen ion concentrations of the buffer, the iso-electric point can be determined by extrapolation or interpolation[6]. The experiments are conducted in a room at constant temperature and a small current is employed, generally 1 milliampere, to minimize heating effects which might cause convection currents. It would be more preferable to conduct the experiments in a water thermostat. The apparatus employed is a modification of the Tiselius moving boundary method[6,7], but it is less complicated and less expensive, and with suitable optical arrangements and proper thermostatic control it can be used for similar purposes, for example, separation of the components in protein mixtures.

An extensive report on the electrophoresis of viruses and their neutralizing antibodies will be published in the *Onderstepoort Journal*.

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[2] Olitski, Boša, *J. Exp. Med.*, **45**, 685 (1927).
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[5] Olitski, Long, *J. Exp. Med.*, **50**, 263 (1929).
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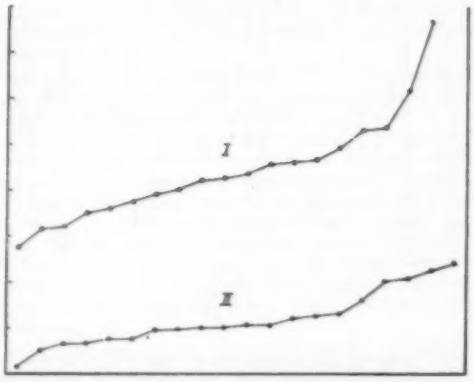
Relation between Corpus allatum and Ovaries in Adult Flies (Muscidæ)

THE adult Muscids examined by me (Musca, Calliphora and Lucilia) possess an unpaired median corpus allatum which is situated dorsal to the œsophagus in the region connecting the neck with the prothorax. Just beneath the corpus allatum lies the aorta, beneath this comes a sympathetic ganglion (ganglion hypocerebrale), and below this lies the œsophagus. An examination of newly hatched unfed females of *Musca domestica* showed the presence of a small rather flat corpus allatum, whereas the same organ of mature females was considerably larger, which was also the case in Calliphora and Lucilia. Thus it seems reasonable to assume that the corpus allatum of adult Muscidæ has a function similar to that of the corpus allatum of the adult female Rhodnius as found by Wigglesworth[1] (cf. also experiments of Weed on Melanoplus[2]), that is, to control the development of the ovaries. In order to test this hypothesis I removed the corpus allatum of rather



RELATIVE AREAS OF CORPORA ALLATA IN CASTRATED CALLIPHORA FEMALES (I) AND OPERATED CONTROLS (II).

newly hatched unfed females of Calliphora and Lucilia. It proved possible to extirpate the corpus allatum solely without damaging the aorta. The mortality was low; out of seventeen Calliphora which had their corpus allatum extirpated three died. After six days at 25° C. and normal feeding (sugar, meat and water) thirteen of the fourteen survivors showed small slightly developed ovaries, whereas one had large ovaries with nearly mature eggs. Thirteen of the fifteen operated controls (none of which died) had large nearly mature ovaries, and two had somewhat smaller ovaries with conspicuous nurse cells; but these ovaries were much larger and much more developed than the ovaries of the thirteen individuals from which the corpus allatum had been excised.

Fourteen about one-day-old unfed Lucilia females had their corpus allatum extirpated. After six days at 25° C. and normal feeding, nine showed small slightly developed ovaries; in one fly the ovaries were somewhat larger, two had ovaries with conspicuous nurse cells, and two had large nearly mature ovaries. Out of ten operated controls, one died, the surviving nine all showed large mature ovaries. The small ovaries of the flies without corpus allatum seem to have stopped growth at the same stage of development.

It would appear from these experiments that the corpus allatum of Calliphora and Lucilia females produces a hormone which regulates maturation of the ovaries, just as is the case in Rhodnius.

The growth of the ovaries in some individuals, in spite of the removal of the corpus allatum, may be explained in one of two ways:

(1) Already before the extirpation the corpus allatum has produced sufficient hormone to induce maturation of the eggs.

(2) A small piece of the corpus allatum may have remained in the animal and produced the hormone necessary for maturation of the eggs.

If the first hypothesis is the right one, it should be possible to determine a critical period for the effect of the hormone by using flies the age of which is exactly known. Experiments have been begun to test this.

In dissecting females of Lucilia, four flies were found to possess an abnormally large corpus allatum and very small undeveloped ovaries. According to the known age of two of these flies, they ought to have been mature. Two explanations seem to be possible:

(1) The corpus allatum has hypertrophied, but is functionless, and for this reason the ovaries remain undeveloped.

(2) There is a mutual influence of the corpus allatum and the ovaries. Some unknown factor has inhibited the development of the ovaries, although the corpus allatum still produces the egg-maturing hormone; but the abnormal ovaries have no effect on the corpus allatum, and so this organ hypertrophies.

If the second hypothesis holds true, removal of the ovaries from newly hatched flies ought to cause a similar enlargement of the corpus allatum as that seen in the abnormal individuals referred to. In this connexion it should be remembered that in some vertebrates castration brings about a considerable increase in size of the pituitary gland, an organ to which the corpus allatum of insects bears some resemblance.

To test this, fifty newly hatched Calliphora females had their ovaries extirpated. Out of these, thirty-one died (the mortality was very high at the beginning, later on I succeeded in lowering it considerably); after seven days at 25° C. the surviving nineteen showed an abnormally large corpus allatum. Out of thirty-five operated controls fourteen died; after seven days at 25° C. twenty showed fully mature ovaries and a considerably smaller corpus allatum than the castrated ones, whereas one fly had abnormal ovaries and correspondingly a very large corpus allatum. All the corpora allata of the castrated females as well as those of the operated controls were examined on living animals and drawn by means of a camera lucida. The areas of the drawings of the individual organs have been calculated and are shown in the two curves of the accompanying graph; to obtain the absolute sizes of the organs these values must be divided by 8,100 as the linear magnification used was 90. It is obvious, as one might have expected, that there is a considerable variation in both groups, but in no case is a corpus allatum from a control as large as a corpus allatum from a castrated female.

These experiments support the second hypothesis stated above. It thus appears that not only does the corpus allatum control the ripening of the ovaries

in the normal adult fly, but also the growing ovaries influence the size of corpus allatum, which in the absence of ovaries hypertrophies. As yet the precise nature of this action is obscure. The investigation is being continued.

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Nov. 30.

[1] Wigglesworth, V. B., *Quart. J. Micro. Sci.*, **79**, 91-121 (1936).
[2] Weed, I. G., *Proc. Soc. Exp. Biol. Med.*, **34**, 883 (1936); Weed, I. G., *Anat. Rec.*, **70**, Suppl., 80 (1937).

Bending of Glass under Long Continued Stress

I HAVE tried the following experiment: A piece of optically flat crown glass 3·5 cm. long, and 1·5 cm. broad and 0·3 cm. thick, was supported on wood at the extreme ends, and the middle was loaded with 6 kgm. applied by means of a wooden chisel edge, which carried a weight moving in guides above. It remained in position from April 6, 1938, to December 13, 1939. At the end of that time the glass was taken out and tested on an optical flat by means of interference fringes. It was found to have been bent, the sagitta of the arc amounting to 2·5 bands or 1·25 waves, that is, about 6×10^{-5} cm.

RAYLEIGH.

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Dec. 13.

Scattering of Mesons and the Magnetic Moments of Proton and Neutron

THE meson theory in its present form exhibits a number of difficulties which are connected with the particular way in which the conservation of charge and the spin enter the interaction between mesons and the nuclear particles. The expression for the anomalous magnetic moment of the proton and neutron[1], for example, diverges as $\int_0^\infty dk$. The cross-section for the scattering of mesons by a nucleus is found to be very much larger than experiments permit and increases rapidly with increasing energy. This would be incompatible with the high penetrating power of cosmic ray mesons. The cross-section for scattering of a longitudinal meson (rest mass μ) with energy ε (momentum p/c) is, according to the present theory, given by[2]

$$\varphi = 4\pi\left(\frac{g^2}{\mu c^2}\right)^2 \frac{p^4}{\varepsilon^2(\mu c^2)^2} \qquad (1)$$

From the analogy of mesons with light quanta, one would expect a cross-section of the order $(g^2/Mc^2)^2$, where M is the mass of the proton, and no increase with energy for $\varepsilon > \mu c^2$. The experiments by J. G. Wilson[3] have shown that the scattering cross-section even for an energy so low as a few times μc^2 (10^8 ev.) is smaller than (1) by an order of magnitude and does not increase with energy.

As can be seen from the computation of (1), both difficulties are due to the fact that the conservation of charge forbids a number of transitions which could occur if mesons were neutral particles[2]. A neutral meson could, for example, be *emitted and absorbed* by a proton. A positive meson can *only be emitted by a proton but not absorbed*. The cross-section for scattering would be of the right order of magnitude if we allow a positive meson also to be absorbed and a negative one to be emitted by a proton, etc., or, in other words, if 'proton states' with charges $-e$ and $+2e$ existed[4]. The introduction of those particles meets, however, with the following difficulties. First, particles of this nature are not observed and are unlikely to have escaped observation if they occur in heavy nuclei. Secondly, if a proton were capable of emitting also a negative meson, the negative meson would give a contribution to the anomalous magnetic moment of the proton of opposite sign and—all other quantities being equal—of the same value as the contribution from the positive meson. Thus, there would be no anomalous magnetic moment at all.

These difficulties can be overcome if we assume that the rest mass of the new particles is considerably *higher* than that of the proton, say, by 25–50 electron masses (see below). The particles would then be extremely unstable and would not play any part in the structure of heavy nuclei. Denoting the mass difference between the new particles and the proton by ΔM, the cross-section for the scattering of a longitudinal meson becomes, for $\varepsilon < Mc^2$, assuming $\Delta M \ll \mu$,

$$\varphi = 4\pi\left(\frac{g^2}{\mu c^2}\right)^2 \left\{\frac{1}{3}\left(\frac{\mu}{M}\right)^3 \left(\frac{\mu c^2}{\varepsilon}\right)^4 + \left(\frac{\Delta M}{\mu}\right)^2 \frac{p^4}{\varepsilon^4}\right\}. \qquad (2)$$

This expression does *not* increase with energy for $\varepsilon > \mu c^2$. If p is approximately μc^2, (2) is smaller by a factor $(\Delta M/\mu)^2$ than (1). A value $\Delta M/\mu$ of approximately 1/5 would be sufficient to bring (2) into harmony with the experimental requirements. For ε greater than Mc^2, φ will probably decrease owing to the relativistic features of the proton.

Similar considerations must be applied to the spin. The spin contributes also to the high scattering cross-section (for transverse mesons). This can be avoided if we introduce also 'higher spin states', for example, heavy particles with spin s of 3/2. Transitions from the normal proton state, s equal to 1/2, to these higher states under the influence of a meson field can be included in the theory in a very simple manner. In the present theory the spin-dependent interaction between a meson field φ and a nuclear particle is f/λ (σ curl φ), where σ is the spin matrix and has only matrix elements for $\Delta s = 0$. σ has to be extended in such a way as to include transitions $\Delta s = 1$. This can be done if we replace σ by the matrix of a dipole moment r/r. For transitions $\Delta s = 0$, the matrix elements of r/r and of σ are identical. If this is done, the cross-section for the scattering of transverse mesons also is small and of the order of magnitude (2). The physical significance of r/r is that of the *intrinsic* magnetic dipole moment of the proton, which is a characteristic feature of the meson theory (r is not, of course, the spacial position of the proton).

As a further result of our new assumptions, the anomalous magnetic moments diverge only *logarithmically*. Such a divergence can, at the present stage of the theory of the meson, scarcely be considered as a very serious difficulty. The relativistic features of the proton have so far been neglected, and it may well be that the logarithmic divergence would disappear if they are taken into account properly. As an upper limit for the validity of the meson theory in the form proposed above, we therefore take the rest energy of the proton. The anomalous magnetic moment of the proton then becomes (in units of the nuclear magneton μ_0)

$$\frac{\mu}{\mu_0} = \frac{16}{3\pi}\frac{M\triangle M}{\mu^2}\frac{f^2}{\hbar c}\left(\log\frac{2E_m}{\mu c^2} - \frac{4}{3}\right), \quad E_m \sim Mc^2. \quad (3)$$

This is of the right order of magnitude when $\triangle M/\mu$ is approximately 1/5, which is the value assumed above.

W. HEITLER.

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University, Bristol, 8.
Nov. 28.

[1] Fröhlich, Heitler and Kemmer, *Proc. Roy. Soc.*, A, **166**, 154 (1938). Yukawa, Sakata and Taketani, *Proc. Math. Phys. Soc. Japan*, **20**, 319 (1938).

[2] Heitler, *Proc. Roy. Soc.*, A, **166**, 529 (1938), and Report of the Eighth Solvay Conference, Brussels, in the press, where the reasons for the high cross-section are analysed.

[3] Wilson, *Proc. Roy. Soc.*, in the press. I am very much indebted to Dr. Wilson for having sent me his MS. before publication.

[4] This possibility was first mentioned to me by Bhabha in a private discussion in connexion with his classical theory for neutral mesons. The whole problem was very much clarified in discussions with Bhabha, Fröhlich and Kemmer.

A Simple Rule for Evaluating Atomic Constants

FROM some of the fundamental constants, natural units can be formed, showing simple relations among many other constants[1]. The fine structure constant is the well-known example

$$\frac{2\pi e^2}{ch} = \alpha = \frac{1}{137} \quad . \quad . \quad . \quad (1)$$

Also α gives a simple relation between the velocity of the electron in the normal hydrogen atom and the velocity of light, and that between the radius of the electron and of the hydrogen atom in the normal state:

$$\frac{v_e}{c} = \alpha, \quad \frac{\gamma_e}{\gamma_H} = \alpha^2.$$

Now let us consider the two following length units: one is for charged particles, and the other for uncharged particles:

$$\frac{e^2}{m_e c^2} \equiv l_e \quad . \quad . \quad . \quad (2) \qquad \sqrt{\frac{Gh}{c^3}} \equiv l_u \quad . \quad . \quad . \quad (3)$$

The ratio of these two,

$$l_e/l_u = \frac{e^2}{m_e\sqrt{Gch}} \equiv A, \quad . \quad . \quad . \quad . \quad (4)$$

will be shown to play a similar part to α. In order to show that, let us employ the de Broglie wave equation in a wide sense.

$$\frac{h}{m_0 c} = l_{\max.} \quad \text{and} \quad \frac{h}{M_{\max.}} = l_0, \quad . \quad . \quad . \quad (5)$$

where the subscripts max. and 0 denote respectively the maximum and minimum mass or length.

From (3) and (5)

$$\frac{l_u^2}{l_0} = \frac{M_{\max.}\,G}{c^2}, \quad . \quad . \quad .$$

which is also a length.

Comparing this with the well-known equation showing the relation between the mass and the radius of the universe, $\frac{M_u G}{c^2} = \frac{\pi}{2}R$,

we may write

$$\frac{l_u^2}{l_0} = \frac{M_u G}{c^2} = l_{\max.}, \quad . \quad . \quad . \quad . \quad . \quad (6)$$

where $M_{\max.}$ and $l_{\max.}$ are identified with the mass of the universe M_u and the longest distance in space, $\pi R/2$, respectively.

It is interesting to find the numerical coincidence in the two following cases:

$$\frac{M_u}{m_0} = 2A^4 \quad . \quad . \quad (7); \qquad \frac{M_H}{m_0} = 3A^2 \quad . \quad . \quad (8)$$

M_H denotes the mass of a hydrogen atom.

From (7) and (8)

$$\frac{M_u}{M_H} = \tfrac{2}{3}A^4 = N = 136 \times 2^{256}, \quad . \quad . \quad (9)$$

N being the total number of particles in the universe[2].

From (5), (6) and (7)

$$\frac{l_{\max.}}{l_e} = \sqrt{2}A^2 \quad . \quad . \quad . \quad . \quad . \quad (10)$$

From (2), (3), (6), (9) and (10)

$$\frac{M_H}{m_e} = \frac{3}{\sqrt{2}}\frac{ch}{e^2} \quad . \quad . \quad . \quad . \quad . \quad (11)$$

Furthermore, the Rydberg constant,

$$R_\infty = \frac{2\pi^2 m_e e^4}{ch^3} \quad . \quad . \quad . \quad . \quad . \quad (12)$$

With any three constants given, we can thus evaluate the rest. Now let us assume the experimental values of c, R_∞ and G, which are comparatively reliable[3].

$$\left.\begin{aligned} c &= (2{\cdot}99774 \pm 0{\cdot}00005)\ 10^{10}\ \text{cm./sec.} \\ R_\infty &= (109{,}737{\cdot}42 \pm 0{\cdot}06)\ /\text{cm.} \\ G &= (6{\cdot}658 \pm 0{\cdot}001)10^{-8}\ \text{cm.}^3/\text{gm.sec.}^2 \end{aligned}\right\} \quad . \quad . \quad (4)$$

Then we can find the values of h, e, m_e and M_H as follows: The value of A is found in (9) to be $6{\cdot}9715 \times 10^{19}$, which is an absolutely definite number.

From (1), (4) and (12),

$$h = \left[\frac{c^3}{16\pi^3 R_\infty^2 (137)^6 A^2}\right]\frac{1}{G} = \frac{K_1}{G} \quad . \quad (13)$$

From (1),

$$e^2 = \left[\frac{c}{2\pi 137}\right]h = K_2 h \quad . \quad . \quad . \quad . \quad (14)$$

From (4),

$$m_e = \left[\frac{1}{A\sqrt{Gc}}\right]\frac{e^2}{\sqrt{h}} = K_3\frac{e^2}{\sqrt{h}} \quad . \quad . \quad (15)$$

From (1) and (11), $M_H = [3\sqrt{2} \times 137]\, m_e = K_4 M$.

The results agree closely with the experimental values as shown in the accompanying table.

Constant	Calculated value	Observed value[4]
h	$6{\cdot}6213 \times 10^{-27}$ erg. sec. ± 10	$6{\cdot}6189 \times 10^{-27}$ erg. sec. ± 36 $6{\cdot}6242$ ± 10 $6{\cdot}6133$ ± 34
e	$4{\cdot}8019 \times 10^{-10}$ E.S.U. ± 7	$4{\cdot}8025 \times 10^{-10}$ E.S.U. ± 4
m_e	$9{\cdot}099 \times 10^{-28}$ gm. ± 1	$9{\cdot}1070 \times 10^{-28}$ gm. ± 14 $9{\cdot}1073$ ± 24 $9{\cdot}0171$ ± 14
M_H	$1{\cdot}6614 \times 10^{-24}$ gm. ± 2	$1{\cdot}6617 \times 10^{-24}$ gm. ± 17
e/m	$1{\cdot}7605 \times 10^{7}$ E.M.U./gm. ± 2	$1{\cdot}7591 \times 10^{7}$ E.M.U./gm. ± 2
h/e	$1{\cdot}3788 \times 10^{-27}$ erg. sec./E.S.U. ± 2	$1{\cdot}3761 \times 10^{-27}$ erg. sec./E.S.U. ± 6 $1{\cdot}3782$ ± 7 $1{\cdot}3773$ ± 1 $1{\cdot}3771$ $+7$

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Kiating, Szechwan.

[1] Eddington, "New Pathways of Sciences".
[2] Eddington, "Relativity Theory of Protons and Electrons".
[3] Bond, *Phil. Mag.*, 624 (1936).
[4] Michelson, *Astrophys. J.*, **82**, 26 (1935).
[5] Dunnington, *Rev. Mod. Phys.*, (11), 75 (1939).

Landau Diamagnetism and the Fermi-Dirac Energy Distribution of the Metallic Electrons in Graphite

IT was discovered by Landau[1] that an electron gas should have, besides its spin paramagnetism, an appreciable diamagnetism due to the quantized orbital motions of the electrons in the magnetic field. If the electrons are *free*, the diamagnetic susceptibility per unit volume of the gas, when it is non-degenerate, is given by the Curie law

$$K = -\frac{n\mu^2}{3kT}, \quad . \quad . \quad . \quad (1)$$

and when it is completely degenerate by the temperature-independent value

$$K = -\frac{n\mu^2}{2kT_0}, \quad . \quad (2)$$

where n is the number of electrons per unit volume, μ is the Bohr magneton, T_0 is the degeneracy temperature defined by

$$kT_0 = \frac{h^2}{2m}\left(\frac{3n}{8\pi}\right)^{2/3}, \quad . \quad (3)$$

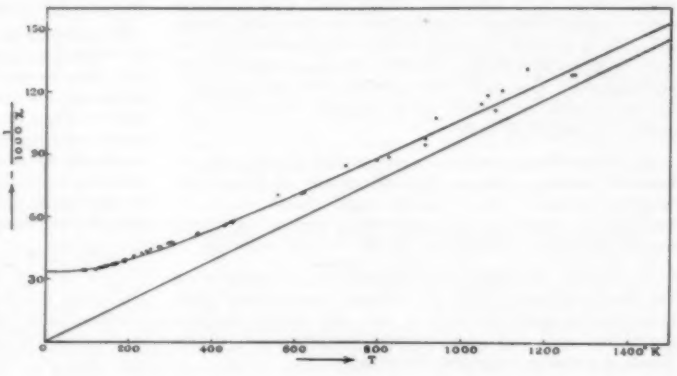
and the other letters have their usual significance. For such a gas the paramagnetic susceptibility is numerically three times the diamagnetic susceptibility and therefore predominates.

For the electrons in any actual metal, which are under the influence of the lattice field, the expressions for the two susceptibilities are naturally more complicated. In particular, the 3:1 ratio between them does not hold, and under special conditions the paramagnetic part of the susceptibility may become negligible in comparison with the diamagnetic part. When further, as in graphite, the metallic electrons can move about freely in a plane, and the freedom of movement is confined practically to the plane, the susceptibility along the normal to the plane will conform to equation (1) at high temperatures, and to (2) at low temperatures, the degeneracy temperature T_0 appearing in (2) being, however, much smaller than that given by (3) for electrons that are free to move in all directions.

These results have been verified in graphite. Its abnormal diamagnetism, which is confined to the direction of its hexagonal axis, conforms to equation (1) at high temperatures, and to (2) at low temperatures, with n corresponding to *one electron per carbon atom*, and $T_0 = 520°$ K.; at all temperatures (in the range investigated) the susceptibility per carbon atom is found to be the same as the diamagnetic susceptibility per electron of a Fermi free-electron gas the degeneracy temperature of which is 520° K. The theoretical values for the specific susceptibility (per gram) of graphite, χ, calculated on this basis, are represented by the accompanying curve, and it will be seen that the experimental values, which are denoted by circles, lie close to the curve[5]. The straight line which the curve tends to reach asymptotically at high temperatures is also drawn in the graph, and corresponds to equation (1).

That one electron per carbon atom should be free to move about in the basal plane agrees with the known structure of graphite. There is a Brillouin zone which can just accommodate 3 electrons per atom, which is a flat hexagonal prism bounded by $\{000,2\}$ and $\{2\bar{1}\bar{1},0\}$, and the energy discontinuities across all the faces of the zone are large. There is a bigger zone bounded by $\{000,2\}$ and $\{2\bar{2}0,0\}$ which can just contain 4 electrons per atom, but the energy discontinuity across $\{2\bar{2}0,0\}$ is small.

The agreement between the experimental data and the theoretical curve plotted in the graph may be regarded as a convincing demonstration of Landau's value for the diamagnetism of a free-electron gas,



and of its temperature variation in accordance with the statistics of Fermi and Dirac.

K. S. KRISHNAN.

Indian Association for the Cultivation of Science, Calcutta. Oct. 21.

[1] *Z. Phys.*, **64**, 629 (1930).
[2] The theoretical curve was plotted with the help of the tables for the Fermi-Dirac integrals given by Stoner, *Proc. Leeds Phil. Soc.*, **3**, 403 (1938). The experimental values are from the measurements by Krishnan and Gangull, *Z. Krist.*, A, **100**, 530 (1939), and some unpublished measurements by Gangull.

Total Solar Eclipse of October 1, 1940

THE Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society has for some years plans prepared for a number of expeditions to observe, what should be a very good eclipse for study, the total eclipse of October 1, 1940. Prof. J. A. Carroll was to have gone from Aberdeen to Brazil with an objective interferometer and an echelon spectrograph for a study of coronal and chromospheric line contours and wave-lengths. The Royal Observatory, Greenwich, and the Cape Observatory were to have gone to Calvinia for a study of the Einstein displacement of stellar images, for a spectrographic study of the chromosphere with a moving-plate camera and for other work. Prof. H. Dingle was to have gone to a station near the edge of the belt of totality for work on wave-lengths and intensities of chromospheric lines near the cusp. The Solar Physics Observatory and the Radcliffe Observatory, Pretoria, were to have joined forces at Nelspoort for a programme including work on the extreme ultra-violet spectrum of the chromosphere and corona, a study of chromospheric line intensities at different heights with a camera having a plate moving intermittently, and polarization studies of the corona and of the sky close to the eclipsed sun.

The outbreak of the War has caused the abandonment of all the expeditions from Great Britain, and the Committee has decided to concentrate on one expedition from the Cape and Radcliffe Observatories to Calvinia. This will carry out as much as proves practicable of the programmes of the various expeditions originally planned. Just how much that will amount to remains to be settled, but every effort will be made to secure as wide a programme of observations as possible.

F. J. M. STRATTON.
(Secretary).

Joint Permanent Eclipse Committee of the Royal Society and the Royal Astronomical Society, Gonville and Caius College, Cambridge.

Points from Foregoing Letters

A. I. Virtanen and M. Torniainen suggest that the discrepancies in their results and those of others experimenting on the excretion of nitrogen compounds from leguminous roots may be ascribed to the quality of the containers, and especially to their porosity. Observations show that the pots giving best results should be large and very porous.

The effects of alkaline reagents on wool have been reviewed by M. R. Freney and M. Lipson. They find that the sulphur and nitrogen contents of merino wool are scarcely altered by immersion in 52 per cent sodium hydroxide up to 30 minutes; that the surface structure of the fibre is unaltered by similar treatment up to 5–10 minutes; that wool treated with concentrated sodium hydroxide absorbs acid dyes evenly; and that a woven fabric treated with 52 per cent sodium hydroxide solution shows a decrease in shrinkage on washing. These studies were extended to treatment of wools with alkalis dissolved in certain organic solvents.

H. Blaschko describes experiments on the inhibition of amine oxidase by derivatives of β-phenyl-*iso*propylamine; it is shown that there exists a parallelism between the awakening action of these drugs and their inhibitory effects on the enzyme.

A. Polson describes and illustrates an apparatus for studying the mobility of animal viruses and their neutralizing antibodies in an electric field. It is a simplified and less complicated modification of the Tiselius moving boundary method.

Ellen Thomsen finds that maturation of the ovaries in adult female flies is controlled by a hormone produced by the corpus allatum, since extirpation of the corpus allatum of young Calliphora and Lucilia females causes the ovaries to stop development at an early stage, whereas operated controls have fully developed ovaries. The ovaries on the other hand influence the corpus allatum, for removal of the ovaries of young Calliphora causes a considerable enlargement of the corpus allatum.

Lord Rayleigh has been able to detect by an interference method a slight permanent set of a strip of glass exposed for many months to a powerful bending moment.

W. Heitler points out that a number of difficulties (diverging magnetic moment of proton, large scattering cross-section for mesons) are due to an inadequate treatment of the spin and charge. It is suggested that 'higher proton states' with charge $2e$, $-e$, and those with spin 3/2 might exist with a rest mass of 25–50 electron masses higher than that of the proton. The cross-section for the scattering of mesons is then of the right order of magnitude and the magnetic moment of the proton diverges only logarithmically.

According to K. S. Krishnan, the abnormal diamagnetism of graphite along its hexagonal axis is the same as the Landau diamagnetism of the Fermi electron gas containing one electron per carbon atom and having a degeneracy temperature of about 520° K.

RESEARCH ITEMS

Osage Warfare

THE late Francis La Flesche, himself an Omaha Indian and a member of the staff of the Smithsonian Institution, Washington, among his numerous studies of the American Indians, made an elaborate record of the rites and ceremonies observed by the Osage Indians in connexion with the conduct of tribal warfare (*Bull. Bureau American Ethnol.*, No. 101, 1939. Washington, D.C.: Government Printing Office, 35 cents). Before taking any action against an enemy, a council meeting was held to choose a leader. This leader had to fast for seven days, and then three complicated and elaborate ceremonies had to be performed. The rituals making up the Wa-shа-be A-thin or war ceremony comprised twenty-eight separate songs, which, interspersed with processions, ceremonial dances and ancient rites, must be sung at just the right times, in proper order, and by the properly designated singers. The Osage, essentially a peaceful tribe who lived in three separate villages in Oklahoma, had also an elaborate peace ceremony, which was intended not only to promote peace within the tribe, but also with their neighbours. They held the peace ceremony in profound veneration because it was believed that the man who had formulated the rite had received supernatural aid in so doing. Though they were peace-loving, intolerable aggression by a neighbouring tribe would force them to take up arms. At the close of the war ceremony a band of warriors was dispatched to meet the enemy. If victory were achieved the band returned with scalps and prisoners, and victory songs were sung.

Distribution of Ceratium

E. STEEMANN NIELSEN has extended his previous researches (1934) on the Ceratia of the Pacific Ocean ("Die Ceratien des indischen Ozeans und der ostasiatischen Gewässer, mit einer allgemeinen Zusammenfassung über die Verbreitung der Ceratien in den Weltmeeren". Von E. Steemann Nielsen. (Dana-Report No. 17.) Pp. 34. (Copenhagen: C. A. Reitzels Forlag; London: Oxford University Press, 1939.) 3.50 kr.; 3*s*.). It was originally intended to add those of the Atlantic, but as these have been thoroughly dealt with by the two German Expeditions *Meteor* and *Deutschland* (Peters, 1932, and Schubert, 1937) this was considered unnecessary. It is now possible to give a general survey of the distribution of the three oceans and their neighbouring seas. Charts are given showing the distribution of the dominant species in the Indian Ocean and East Asiatic waters and tables of the horizontal and vertical distribution of all of them, with a review of their distribution in the different regions and the numbers in the Nansen net in the stations poor in plankton. The most striking fact that emerges is the homogeneity of distribution and the absence of geographic races or species. As was noted in the southern Pacific, the author regards the two factors temperature and oceanic-neritic influence as of supreme importance in the determination of the distribution of Ceratia. Schubert (1937) regards salinity as of great significance, but the observations of Peters (1932) in the Atlantic and of Nielsen in the Pacific and in the present work are opposed to this. It is agreed that extreme salinity is of importance; but within the limits shown in the open ocean it has apparently little influence on distribution of the Ceratia. The material came almost exclusively from tropical waters. It is found that all Ceratium species which can live in tropical waters are inhabitants of both hemispheres. The cold-water species are, however, only inhabitants of one of them. *Ceratium fusus*, which is well known from both warm and temperate water, inhabits both hemispheres. In the Antarctic there is the cold-water species *Ceratium robustum* inhabiting the whole region, and in the Arctic *Ceratium arcticum*. Most warm-water Ceratia are common to all three oceans, but there are certain forms of purely tropical species found only in the Indian Ocean and Pacific, or only in the Atlantic. This is especially the case with neritic species. The Indian Ocean and the Pacific represent one region so far as the purely tropical Ceratia are concerned.

Offspring from Artificially Activated Ova

S. PINCUS (*Proc. Nat. Acad. Sci.*, **25**, 557–559; 1939), following up his previous report that three litters of rabbits had been obtained from recipients of artificially activated ova, shows by further breeding that the transplanted ova which have been activated give rise to normal offspring without fertilization. For example, eighteen chinchilla ova transplanted after activation into an albino doe, which had been made pseudo-pregnant by pituitary extract, gave rise to two chinchilla females, one of which has been further bred by mating to an albino male, giving a second generation of nine chinchilla and three albino.

Seed Weight in the Tomato

THE weight of the seed and embryo in the tomato is dependent on the genotype of the plant, the external environment in which the fruits develop, and also upon certain internal factors such as the number of seeds developing in the fruit and the number of fruits on the truss. L. C. Luckwill (*New Phytol.*, **38**, 181–189; 1939) has calculated correlations and regressions between seed weight and these internal factors, and has estimated that variations in seed number may be responsible for variations in mean seed weight as large as 45 per cent. The maximum variation due to differences in the number of fruits developing on the truss was estimated at 10 per cent of the mean. It is suggested that these correlations may arise from causes connected with the nutrition of the developing ovules similar to those which give rise to the negative correlation between birth weight and litter size in certain mammals. These results have a great influence on the design of experiments on heterosis (see also NATURE, Nov. 25, p. 908).

Heterochromatin in the Chromosomes of Drosophila

B. P. KAUFMANN (*Proc. Nat. Acad. Sci.*, **25**, 571–577; 1939) has studied the distribution of 627 breaks due to X-rays in the *X*-chromosome of *Drosophila melanogaster*. He shows that there is no difference in frequency or distribution of breaks near or in an inversion as compared with wild-type chromosomes.

There is a significant increase of breaks in certain regions of the chromosome, particularly the known heterochromatin region, and in sections of the euchromatin part. From this and other evidence it is shown that the increased frequency of breaks in the sections of euchromatin is due to the presence of intercalary heterochromatin material.

Interxylary Cork

A PAPER in *Lloydia* (see p. 24 of this issue) by R. A. Dietterт upon the morphology of *Artemisia tridentata* directs renewed attention to this interesting phenomenon. When annual growth recommences in the stem in the spring a single layer of meristematic cells, the interxylary phellogen, remains on the surface of the last-formed xylem of the previous year. Quite late in the summer, in July and August, these initials give rise to several layers of cells which suberize progressively in a centrifugal direction. As a result the wood of the current season is carried out on to a wider periphery by this late cork development; the rays are thus expanded and also the cells of the rays, in the region of the cork layer, are suberized progressively in an outwards direction. We thus have the most recently formed layer of wood cut off from all older layers of wood by a sheet of periderm, a process that is repeated in successive years. This must have a most important effect upon the water economy of the plant, which has a wide distribution throughout the western United States. E. H. Moss has directed attention previously to the presence of such rings of cork in herbaceous perennials (NATURE, **133**, 689; 1934), concluding that they afford excellent protection against desiccation and various deleterious effects that might be associated with the dying down of annual shoots.

Softening of Rubber

CRUDE raw rubber as received by manufacturers has to be reduced by heating and mechanical working to a soft plastic condition to permit incorporation of the essential compounding ingredients. Experiments have been carried out by V. H. Wentworth and J. D. Hastings at the Rubber Research Institute of Malaya (*J. Rub. Res. Inst. Malaya*, **9**, Comm. 236 and 237) to determine if softening could not be more economically effected by modifying the preparation of the rubber on the plantation. A promising line of attack is the treatment of latex prior to coagulation with substances such as zinc soaps which bring about softening in the course of the normal smoking and drying processes. Pine tar is an effective softener in common use, and in view of the fact that it was found possible to incorporate large quantities into the latex, it is suggested that master-batch preparation on estates might be worthy of consideration by the manufacturers. The incorporation of emulsions of 'peptising agents' into the latex in the pre-coagulation stage is another method which has been used during the last two years for softening purposes. It is now shown that the degree of softness achieved depends to a large extent on the temperature at which the wet sheet is afterwards dried, high temperature in the early stages assisting the softening markedly.

Control of Loose Smut Disease

THE original delicate method of controlling the loose smut fungi upon wheat and barley by dipping the seed in hot water for a short period has gradually given place to the more workable treatment of steeping for a longer time at a lower temperature. G. Howard Jones has designed an automatic apparatus for dealing with the seed on cereal improvement farms in Egypt (*Min. Agr. Egypt Tech. and Sci. Service Bull.* 220. Govt. Press, Bulâq, Cairo, 1939. P.T. 3). About 150 lb. of seed contained in a hopper is emptied into a wire basket within a heating bath by means of an automatic electric relay control apparatus which also switches on the heating units. Six hours later, the same apparatus rings an alarm; the wire basket is then hoisted from its bath and the seed spread upon trays to dry in the sun. The heating is accomplished during the night, so that full advantage may be taken of the drying effect of the sun, and thus a continuous series of daily treatments is maintained. Germination is affected to a slight, but commercially insignificant, extent by the process.

The Ogasima (Japan) Earthquake of May 1

THIS is the subject of three papers by T. Hagiwara, N. Miyabe, R. Takei and Y. Otuka (Earthquake Research Institute, Tokyo Imperial University, 17, Part 3, September 1939), who have studied respectively the shock and aftershocks, the deformations of the earth's surface and the geological implications. The earthquake occurred about 14h. 58m. on May 1, 1939, and shocks of the same magnitude followed twice with an interval of two minutes, in the neighbourhood of Ogasima and the neck of a small peninsula in the Akita Prefecture. The aftershocks which followed the main earthquake were observed by four portable seismographs installed temporarily in the peninsula, and these aftershocks were found to have had epicentres near to where the surface effects were greatest within the peninsula, but not all originated in one place. Hundreds of dwelling-houses were destroyed by the earthquake and a landslide which followed it, and 29 people were killed. The surface effects including damage to property, surface cracks and permanent movement were found to be greatest (1) in the neighbourhood of Kitaura-mati on the northern seashore, where also a cliff extending about one kilometre along the Japan Sea slid down to the sea and destroyed more than a hundred houses; (2) near the villages of Anden and Kotogawa where the damage was greatest and surface features most distorted; (3) on the northern slope of Kanpûzan volcano; and (4) in Katanisi-mura, in the narrow isthmus dividing Lake Hatirôgata from the Japan Sea. In several places where the ground was permanently deformed, the horizontal displacements were up to 3·9 m. whilst the vertical displacements ranged about 1 m. Yanosuke Otuka is of the opinion that these displacements were due to surface ground disturbance and that they had no tectonic significance. The landslide however was due to slipping along the bedding plane of the Kitaura sand and mud alternation of the Middle Neogene.

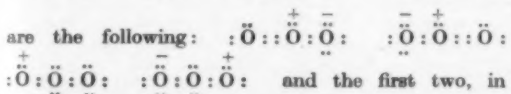
Meteorology of the Byrd Expedition

SUPPLEMENT No. 41 of the *Monthly Weather Review* of the U.S. Department of Agriculture, issued last October, is an account running to 377 pages of the meteorological results of the Byrd Antarctic Expeditions of 1928–30 and 1933–35, by C. Grimminger and W. C. Haines. Part of the data had been prepared in the Antarctic in 1929–30 by W. C. Haines and H. T. Harrison. Apart from the

introduction, the volume is occupied by the tables in which the meteorological observations are set out. These include the observations made on the various ships of the Expedition between New Zealand and the Bay of Whales, those made at Little America (the base of the Expedition in lat. 78° 34′ S., long. 163° 56′ W., which was at nearly the same spot as "Framheim", where Amundsen obtained 10 months' records in 1911–12) and at the Bolling Advanced Weather Base, which was occupied by Admiral Byrd alone from March 26 to October 11, 1934, and on various sledging journeys. Upper air observations were made with the aid of kites carrying Marvin kite meteorographs. On the first expedition a kite meteorograph was installed on the aeroplane that formed part of the equipment, and on the second expedition an autogyro was taken, primarily for the purpose of making temperature observations, because of difficulties that had been encountered with kites. The best method of mounting the kite meteorograph was found to be that of suspending it within the fuselage to the rear of the cabin on rubber cords, ventilation being secured by having a tube of wind-proof cloth leading from an air vent in the top of the fuselage to the meteorograph. This enabled a perfect record to be obtained on the flight to and from the South Pole. The completeness of the meteorological record under the most trying conditions testifies to the keen work not only of the meteorologists but also of those who assisted, notably the leader of the expedition during his lonely vigil during the whole of an Antarctic winter night less than 10° from the Pole. In spite of difficulties arising from the intense cold, from drifting snow and frosting of the lenses of the pilot balloon theodolites, pilot balloon observations of upper wind were made at Little America on 569 occasions during the 310-day period when the pilot balloon station was in operation on the second expedition. A critical discussion of the results obtained will, it is hoped, be made in due course, although no objection can be made to this early publication of the raw material for such a discussion.

Structures of Ozone and Some Compounds

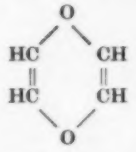
THE structures of ozone, silicobromoform ($SiHBr_3$) and dichlorogermane (GeH_2Cl_2) contain contributions from several forms among which resonance exists. The dipole moments of these substances have been measured by G. L. Lewis and C. P. Smyth (*J. Amer. Chem. Soc.*, **61**, 3063; 1939), ozone being measured in solution in liquid oxygen, silicobromoform in heptane and dichlorogermane in carbon tetrachloride. The moments (in usual units) are O_3, 0·49; $SiHBr_3$, 0·79; GeH_2Cl_2, 2·21. The finite moment of ozone excludes the symmetrical triangular molecule in which each atom is linked to two others by a single bond. A linear molecule with a central atom joined to one on each side by identical bonds is also excluded. A bent structure, analogous to that of sulphur dioxide, seems indicated. The electronic structures which seem likely to the ground state of the molecule



are the following: and the first two, in which each atom has a complete octet of electrons, should make the largest contribution. All these structures are bent, the O—O—O angle being not less than 120°. It is concluded that the two oxygens linked to the central atom form an angle of about 140° and in any case very obtuse. The two identical bonds have some polar character as a result of resonance among forms containing semi-polar bonds. The results for silicobromoform and dichlorogermane show that silicon compounds tend to have minimum moments in the group of carbon, silicon, germanium and tin compounds, which, otherwise, increase in the order named.

Dioxadiene

THE compound used as the fundamental or parent nucleus for dioxane, dioxene and their derivatives, namely:



previously called dioxin, has now been prepared for the first time by R. K. Summerbell and R. R. Umhoefer (*J. Amer. Chem. Soc.*, **61**, 3020; 1939) and called dioxadiene. It was obtained by the action of magnesium and magnesium iodide on 2,3,5,6-tetrachlorodioxane in boiling *n*-butyl ether (no reaction occurred in the lower boiling ethyl ether). Other reactions tried did not succeed. Dioxadiene boils at 75°, which is 26° lower than dioxane, it is insoluble in water, and in its chemical properties it behaves generally as an unsaturated ether. It is, however, more stable towards dilute acid than other unsaturated ethers such as dioxene and vinyl ether. It polymerizes in two to three weeks to a hard colourless solid, not melting below 250°, and insoluble in water, benzene, etc. Dioxadiene reacts vigorously with bromine and adds on hydrogen chloride. The reactions indicate that the unsaturation in the molecule is modified to a marked extent by conjugation with the ether oxygens.

Determination of Meteor Velocity from Zenith Attraction

IN a recent paper, Hideo Inouye shows how meteor velocities can be determined by finding the radiants of a shower at fairly short intervals when the radiant is not far from the meridian (*Mon. Not. Roy. Astro. Soc.*, **99**, 9; October 1939). The observations are made when the radiant is near the meridian because the effects of the diurnal aberration in displacing the radiant are then negligible. It is well known that the attraction of the earth on a meteor causes a movement of the radiant towards the zenith, and the amount of this movement depends upon the velocity of the meteor and also on the distance of the radiant from the zenith. From the displacement of the radiant when it is at various altitudes an angle θ can be easily found, and from this latter the value of the velocity is read off from a table. An example is given from the Leonid shower of November 13, 1937, and from this the velocity of the meteors associated with this shower is 59·5 km./sec. The actual value is 71·4 km./sec., and it is suggested that this can be explained by errors of observation in the amount of the displacement. Although the method is interesting, it does not lend itself to very high accuracy.

COPROPHAGY IN THE RABBIT

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COPROPHAGY in the rabbit was discussed in NATURE (1939) under the title "Does the Rabbit Chew the Cud?" and the early observations of Morot (1882)[1] were confirmed by Madsen[2] and by Taylor[3]. These observations showed that two kinds of fæces were voided by the rabbit, the familiar dry pellet type during the day and a soft mucous type during the night, rarely observed because the animal collects them directly from the anus and swallows them again. Madsen suggested that the difference in the two types was due to an intestinal rhythm in the rabbit itself and that refection was a normal physiological process in this animal. Taylor, on the evidence of coccidial oocysts found in the stomach and of experimental feeding with lycopodium spores, agreed with Madsen and emphasized the necessity for recognition of this peculiar attribute of the rabbit in the correct interpretation of parasitological and physiological work in which this animal is employed. In the latter connexion he cited specific experiments of mine on the fate of ingested copper, some of the data of which may be more fully discussed.

In one of the earlier experiments it was observed that the elimination of 50 mgm. of copper (as the sulphate, dried on to food) was spread over five weeks: 22·5 mgm. appearing in the first week, 14 mgm. in the second, 6·4 mgm. in the third, 2·4 mgm. in the fourth and 1·3 mgm. in the fifth week, the remaining 3·4 mgm. being probably accounted for by summation of analytical error over some 35 analyses. Other evidence was available that the retention of such large quantities of copper could not be due to absorption from the alimentary tract and storage within the body with subsequent elimination, and the only rational explanation seemed to be refection of the copper-containing fæces. Since, however, half the quantity of copper finally accounted for was still present in the tract after a week, calculation shows that 80–90 per cent of the total fæces excreted must have been re-eaten, according to the interval assumed for complete passage of food through the tract, or 4–9 times the amount which actually passed through the wire-mesh floor of the cage. Such a high degree of refection seemed incredible even with an animal receiving a quantity of food well below its maximum appetite level.

On repeating this experiment, killing the animal after a week and analysing the contents of the tract, the tract itself as well as the major tissues, 38 mgm. of the copper fed were found to have appeared in the fæces during the week as against 22·5 mgm. in the previous experiment and a further 12 mgm. were found in the contents of the tract (2·5 mgm. in stomach, 1 mgm. in the intestines, 5 mgm. in the cæcum and 3·5 mgm. in the rectum) while the wall of the tract itself and the tissues contained only the usual 0·2–0·5 mgm. per cent fresh material. The high amount of copper found in the stomach contents afforded particularly strong evidence of refection, and calculation from the observed excretion of copper suggested reconsumption of 50–70 per cent of each day's rectal deliveries.

Another experiment with a rabbit provided with a wooden collar, presumed large enough to prevent the animal getting at its anus, was undertaken, and the dry matter and copper fæcal excretion studied. In a five days preliminary uncollared period, an average daily excretion of 9·5 gm. dry matter was observed, of the ordinary familiar pellet type. After attaching the collar, 54·5 gm. dry matter appeared within twenty-four hours, 37·5 gm. being present in the normal 'day' fæces and 17 gm. in the softer 'night' fæces type, consisting of mucous covered agglomerates of much smaller pellets suggestive of loganberries. On the assumption that 9·5 gm. dry matter would also have been obtained on the sixth day but for the collar, the actual appearance of 54·5 gm. suggests that 45 gm. would have been eaten had the animal been able to get at its anus, a calculated 'refection level' of 82 per cent of the total excretion. This is astonishingly high and may perhaps have been accentuated by irregularity of rectal evacuation although there is no reason for such an assumption.

50 mgm. of copper had again been incorporated with the food the day the collar was attached and 96 per cent was recovered in four days: 10 mgm. on the first day, 25·5 mgm. on the second; 6·9 mgm. and 5·7 mgm. on the third and fourth days respectively; the remaining 4 per cent appeared over the next few days. This presumably represents the ordinary rate of passage through the tract, the lag over the third and fourth days probably being explained by the large storage capacity of the cæcum, and is in striking contrast to the behaviour noted in rabbits allowed to practise their customary coprophagy.

Excluding the first day of high fæcal excretion after collaring, the average dry matter over the next fifteen days was 13·7 gm. daily, 4·2 gm. more than in the five uncollared days on the same ration. This at least suggests that refection increases the extent of digestion of the dry matter of the food, and taking the daily dry matter intake as 37 gm., digestion coefficients for the collared period were 63 per cent, and for the uncollared period 77 per cent when the material was passed through the tract several times. As showing the extent of the craving for fæces, after twelve days the rabbit discovered a cunning method of circumventing the collar and was able to secure occasional pellets from the anus although often rolling over in the process.

On replacing the collar by a larger one and again feeding 50 mgm. copper a few days later, 6·5 mgm. appeared within twenty-four hours. The collar was then removed. Less than 4·5 gm. dry matter appeared over the next twenty-four hours and copper recovery diminished although the output of fæcal matter again rose and a further 36·5 mgm. copper were recovered in the ensuing seven days. On again replacing the collar practically all the remaining copper appeared in two days, during the first of which the fæcal dry matter rose from 13 gm. to 28 gm. with the reappearance of 'night' fæces. Again on the assumption that the actual rectal output was the

same as on preceding days, the drop of fæcal dry matter actually collected, 13·7 gm. to 4·5 gm., represents a refection of 9·2 gm. or 67 per cent of the total passing the anus. Similarly when the collar was next replaced the rise in fæcal dry matter from 13 gm. to 28 gm. represents a minimum refection of 15 gm. or 54 per cent—the real figure being higher if one assumes a tendency to greater retention in the tract when refection is suddenly prohibited.

Naturally the degree of refection varies with each individual rabbit, with the amount of food, probably with the chemical composition of the food and with disturbance of habit by intermittent collaring. In the last mentioned experiment the refection level apparently varied from 54 to 82 per cent at different periods, and in the first experiment, in which elimination of copper was spread over five weeks, the average daily refection must have exceeded 80 per cent of the total fæces passing the anus.

A further point of interest is the difference in ash content, on a dry matter basis, between 'day' and 'night' fæces on the particular diet employed: 6·5–10 per cent in the 'day' fæces and 11·7–14·5 per cent in the 'night' fæces. Further investigations are in progress regarding other differences in chemical composition and on the relation between time of feeding and the appearance of pellet types.

[1] Morot, Ch., *Mém. Soc. centr. méd. vét.*, **12**, Sér. 1 (1882).
[2] Madsen, H., NATURE, **143**, 981 (1939).
[3] Taylor, E. L., NATURE, **143**, 981 (1939).

CHARITY AND THE STRUGGLE FOR EXISTENCE*

T. H. HUXLEY in his famous Romanes Lecture startled the University of Oxford by saying, or seeming to say, that the cosmic process as represented by the struggle for existence "works not for righteousness but against it". Apparently his contention was that the use of tooth and claw was to be contrasted with the more civilized methods of maintaining the race in being. Huxley, however, did not define the precise function to be attributed to the higher morality as a means of survival. It remains, therefore, for the anthropologist to inquire what actual evidence there is for the view that what is salvation for the brute, or even for the savage, spells damnation for a reasonable being knowing good from evil.

"Real progress is progress in charity, all other advances being secondary thereto"[1]. Huxley himself would have been the first to insist that what he terms ethical process involves 'charity' as a typical manifestation of pure goodness. If 'charity' then be taken as a mark of the spiritual man, how far does a disposition towards it set him at variance with his former self, the natural man?

Now, on the plane of anthropology, Dr. Marett disclaims at once any intention of trying to determine more than the biological function of morality, and in particular that of charity as its crowning grace. This method can at least furnish an external criterion of their worth. On a long view, such as that taken by the anthropologist, it becomes plain that certain types of conduct are of greater biological advantage than others—that they promote the survival of those who live accordingly. Further, they have the advantage that the anthropologist, who must with his evolutionary outlook insist on continuity at all costs, can recognize in man a steadily increasing purpose to make the best of his life, and he cannot but treat primitive and advanced morality as lineally related expressions of the same basic motive.

Charity would seem to be rooted in mother-love, on which the protracted infancy of our species makes it specially dependent; for they both involve a like readiness to give regardless of desert and with no thought of a return. At the same time, having regard to certain tendencies in human nature in virtue of its bi-sexual constitution, justice may be linked with fatherhood, while a certain virtue which may be roughly identified with holiness represents the effort to transcend the psychological opposition between them.

Justice then may be regarded as the outcome of male masterfulness, which in course of time establishes a system of rights and duties having strict reciprocity as its ideal limit. Father-right, however, has prevailed over mother-right in the evolution of the greater society, so that modern civilization is threatened with a type of authoritarian State given over to a harsh legalism insufficiently tempered by mercy. That so one-sided an exploitation of man's spiritual resources is unhealthy is possibly illustrated by the fact that the world's successive civilizations, all alike built up on power politics, hitherto have invariably come to grief.

Family life, however, outlasts the decay of nations; and for the anthropologist, it is suggested, the key to the understanding of human development on its moral side is not so much the evolution of the State as that of the family. In no department of life has experiment played a greater part, though only on the cultural side is this possible, since the biological conditions are virtually fixed. It might even be argued that the whole social process is fundamentally an attempt to resolve the temperamental conflict of sex into a harmony sufficient to ensure the continuation of the species.

Here then in family life lies the best hope of striking a balance between gentleness and firmness in human intercourse.

As for what has here been called holiness, the history of religion shows that there have always been high-minded persons who tended to turn away from sex as too disturbing a factor in the moral life. But to starve by way of sublimating sex can at best be but an indirect way of promoting the survival of the race. It must be left rather to ordinary men and women to make their characteristic but diverse contributions to a morality which will ever consist in a compromise between discipline and love. Such is the two-fold aim of that traditional nurture which has become man's second nature and alone can bring him safely through the ages that lie ahead.

* Charity and the Struggle for Existence (Huxley Memorial Lecture for 1939). By Dr. R. R. Marett. Pp. 14. (London: Royal Anthropological Institute, 1939.)

[1] "Head, Heart and Hands", by R. R. Marett, p. 40. (London 1935.)

SOME INDIAN ORIGINS IN THE LIGHT OF ASTRONOMICAL EVIDENCE

AMONG recent communications to the Royal Asiatic Society of Bengal, several dealing with details of a technical character in palæographical and historical studies bear upon points of interest and importance in the archæological investigation of the origin and development of Indian civilization*.

In a discussion by S. N. Chakravarti of the development of the Bengali alphabet from the fifth century A.D. to the end of Mohammedan rule, in which the argument depends upon a detailed examination of variations in form, the Bengali alphabet is derived from a proto-Bengali of the tenth century, which in turn it is suggested can be traced back to certain ancient prototypes in the pictographic script of the Indus Valley civilization. It is also suggested that the Indian system of notation, for which affinity with Egyptian demotic has been indicated, is in reality indigenous in origin, probably to be traced back to the seals of the Indus Valley.

Conclusions of a more surprising character, based on astronomical evidence, have been formulated by P. C. Sengupta in a series of papers discussing chronological and other problems in early Indian history. The first of these deals with the date of the Bhārata battle, the great conflict which forms the central incident of that great monument of early Indian literature, the Mahabharata. The date for this battle, as usually accounted, is indicated by three lines of traditional evidence at 3102–3101 B.C. The author, on an examination of one of these traditions, the evidence of the Yudhiṣṭhira era, has shown that the astronomical references justify the inference that the great battle took place in 2449 B.C. He now turns to examine the remaining two traditions, the Āryabhaṭa and the Purāṇic traditions.

The calculation depends upon the dating of the Kaliyuga, which the Mahabharata states had just begun and to which the date February 3102 B.C. is assigned. It cannot, however, be reconciled with the astronomical Kaliyuga, and is shown to be based upon an astronomical calculation in which conditions are correct only for A.D. 499, when the Hindu scientific Siddhantas came into being. It depends upon an incorrect assumption of the position of the solstices of Pandava times and an incorrect annual rate of the precession of the equinoxes. A corrected back calculation from conditions in the heavens corresponding to those recorded in the Mahabharata, that is, conditions in the period February 1924–35, gives a date January 10, 2454 B.C. as the beginning of this Kaliyuga era, and 2449 B.C. as the year of the battle.

This leads to further inquiry as to observation of the solstices in successive ages. This was determined by the phases of the moon in the month of Māgha, a lunar month of which the beginning at the present time may be from January 15 to February 11. In the calendar of the Vedic Hindus, this month started the five-year cycle which began "when the sun, the moon and the Dhaniṣṭhās (Delphinis) cross the heavens together; it is the beginning of the Yuga, of the month of Māgha or Tapas, of the light half and of the sun's northerly course". From the astronomical conjunctions to which reference is made in the Mahabharata, it would appear that this reckoning was started (traditionally by Brahma) at about 3050 B.C.

There are three peculiarities of this month: (1) it began with a new moon near Delphinis; (2) the full moon was near Regulus; (3) the last quarter was conjoined with Antares. Such a month did not come every year, but it was the standard month of Māgha. In our own times it occurred in 1924 during February 5–March 5, a year which for the purpose of this investigation is taken as the gauge year.

References in the Brahmanic and other works directly state or indicate the winter solstice of successive Vedic periods. From these astronomical references fixing the position of the moon in relation to the winter solstice and the beginning of the month Māgha, a matter of ritual importance in connexion with the year-long and other sacrifices, it has been possible to fix by calculation back from the corresponding conditions in recent years a series of dates beginning with 3550 B.C., the earliest date of the age of the Brahmanas, and covering a period of 1,450 years with a possible error of 400 years. It was thus during this period that the Brahmanic literature developed.

Next is considered Madhu-Vidyā, or the "science of Spring" which as here interpreted is really the knowledge of the celestial signal for the coming of spring, addressed to the Aśvins, who are identified with α and β Arietis, the prominent stars in the Aśvini cluster. The three stars, α, β and γ Arietis, form a constellation which is likened to the head of a horse. The Aśvins are spoken of in several passages of the Rig-Veda as riding in the heavens in their triangular, three-wheeled, and spring-bearing chariot.

From certain references it would seem that when the car of the Aśvins first becomes visible at dawn, spring began at some place in the latitude of Kurukṣetra in the Punjab. The jealously guarded Madhu-Vidyā or "science of Spring" was thus nothing but knowledge of the celestial signal of the advent of spring—the heliacal rising of α, β and γ Arietis.

By astronomical calculation it can be shown that this event at the latitude mentioned took place at, say, 4000 B.C. Hence it is beyond question that the Vedic Hindus could find accurately the beginnings of winter, spring and all seasons of the year.

The earliest epigraphic evidence of Vedic chronology from cuneiform inscriptions referring to Indra and other gods of the horse-riding Kharri or Mitanni dates from about 1400 B.C. In the absence of further epigraphic evidence, it is pointed out, this definite finding of the astronomical evidence derived from the literature as to the antiquity and chronology of the Vedas must be allowed to stand. It establishes, it is maintained, that the civilization of the Vedic Hindus was earlier than that of the Indus Valley as evidenced by the remains at Mohenjo-daro.

Finally, in "When Indra became Maghavan", Mr. Sengupta turns to the relation of the Vedic god Indra, the "shedder of rain" and "the wielder of

* See *J. R. Asiat. Soc. Bengal, Letters*, **4**, 3 (1938); issued September 1939.

the thunderbolt" to the summer solstice. The references to this god in the Rig-Veda, when divested of all allegory, suggest that he is the god of the summer solstice, while the clouds as represented by a demon are unwilling to yield up their watery store until assailed by the thunderbolt hurled by the god.

The monsoons which bring the rains usually burst about June 22 and there is usually a drought which lasts for about a month before the monsoon comes. The demon Suṣṇa (drought) is killed by Indra. The fight with Vrtra or Ahi, the cloud demon, is thus an annual affair which takes place when the sun enters the summer solstice, Indra withdrawing his rain-giving (or annual) bow with the coming of autumn.

When did Indra become the slayer of Vrtra ? The answer given by the Rig-Veda is when Indra by the rising of Maghas became Maghavan. Maghas to us must be the constellation Maghās consisting of α, η, γ, ζ, μ and ς Leonis, at the heliacal rising of which the sun reached the summer solstice at the latitude of Kuruksetra (lat. 30° N.). This it is shown must have happened in 4170 B.C.

APPLICATIONS OF PHOTOGRAPHY TO ENGINEERING

IN a paper delivered to the Junior Institution of Engineers on November 4 and published in the journal of the Institution for December, Mr. A. H. Styring gives an account of several practical applications of photography to engineering. He lays special stress on infra-red photography, photography by polarized light, X-ray photography and high-speed photography.

Infra-red sensitive materials have proved of the greatest value in spectroscopy and astronomy. Photographs of the solar spectrum have revealed lines as far as 13,500 A. wave-length. Distance appears hazy on non-colour sensitive materials because the suspended particles of water vapour in the atmosphere, which are transparent and therefore affect vision only slightly, act as a thick medium for deep violet and ultra-violet waves, scattering them, and producing an effect similar to that which would be seen if we were to try to look through a sheet of finely ground glass.

When photographing at great distances, the best results are obtained with infra-red sensitive materials and filters. Infra-red waves are less easily scattered by water and dust particles in the intervening atmosphere than are the shorter rays in the normal visibility range. The power of haze penetration is important and has an engineering application. Research is in progress for the adaptation of infra-red sensitive materials for navigational purposes. Good work has been done up to six miles, and distances up to twenty miles have been claimed. Special infra-red cameras have been fitted to trans-Atlantic liners in which infra-red film is exposed at 20-second intervals, each picture being developed and fixed rapidly for viewing in roughly one minute. In the same way application has also been made for military purposes, permitting vision of objects invisible to the eye. Other applications depend mainly on the fact that many dyes and pigments, which absorb strongly in the visible region, either transmit or reflect freely in the near infra-red region. In consequence it is possible to reveal by infra-red photography many structures invisible to the eye, and to differentiate between materials which to the eye appear similar. This has a useful application in photomicrography. Another promising field lies in the direction of research in the realm of elevated temperatures. Heat rays are recorded by infra-red materials.

Polarized light photography is based on the fact that light reflected from a non-metallic surface at an angle of 32–37° is strongly polarized. At other angles except 90° it is to variable extents. For this reason the reflection from natural things, separately and combined, has much of the light polarized. The unaided eye fails to detect this, but many objects viewed by a polarizing screen assume a new and strange beauty. The use of polarized light in photography is made possible by the way in which all natural substances reflect polarized light. When a ray of light falls on a sheet of paper, for example, the light that is reflected is composed of two parts, which are called 'specular' and 'diffused' components. The specular component produces 'gloss' and enables us to see more or less distinctly an image of the source of light. If we look at our object through a polarizing screen, we find that we can orient the screen so that practically all the specular reflection is stopped and we see the object by diffusely reflected light. Polarizing screens have recently been made from a quinine-iodine compound called 'Herapathite', a thin layer of the substance being cemented between two sheets of plane glass. The use of such a screen permits photographs to be taken obliquely through water or glass.

The principal application of X-rays to industry is the examination of articles during manufacture. Increased penetration is constantly being achieved and the definition of radiographs has been greatly improved. It does not necessitate expensive castings or forgings being either sawn asunder or otherwise destroyed or mutilated. With a little experience, defects such as gas cavities, sand and slag inclusions, metal segregation, etc., can be easily detected. The atomic weight of the substance examined has a marked effect on the depth of penetration of the rays. Apart from this fact, penetration depends on the voltage applied to the tube. For example, 40,000 volts will penetrate 4 in. of aluminium, but it requires 250,000 volts to penetrate 4 in. of steel. The gamma radiations of radioactive substances have latterly been employed for the same purposes as X-rays. Owing to their shorter wave-length the gamma rays have a much greater penetrative power.

The author points out that with high-speed photography, the ordinary type of motion camera which has an intermittent film motion and shutter can only be speeded up to ten times its normal speed before rupture takes place. Cameras operating at higher speeds have continuously moving films. In the mechanism of the high-speed camera perfected by the Western Electric Co. and Kodak Ltd. there is incorporated a clock, and this records the exact time when each event in a cycle takes place.

FLUID FILLING-MEDIA FOR ELECTRICAL APPARATUS

THIS paper, written by F. Meyer of the General Electric Co., was allocated for reading to the Institute of Electrical Engineers on November 23 and is now published. The author discusses the everyday fluid insulators used for electrical apparatus, particularly with transformers, and advances suggestions for improving the British Standard Specification (148, 1933, Insulating Oils for Electrical Purposes). In addition he discusses the properties of chlorinated diphenyls, perhaps the commonest non-inflammable liquids used for this purpose, which are known in America under the technical name 'pyranol'. The particular requirements of oils suitable for condensers are also considered.

When oil was first adopted for filling transformers and switchgear, use was made of the best existing kind of oil. Going back no farther than thirty years ago, we find that oils were fully approved that would now be instantly rejected, both with regard to their electrical properties and their other physical characteristics. In successive editions of the British Standard Specification 148, the requirements have been tightened up until the oil which satisfies Spec. 148 could be safely used medicinally. Unfortunately the demand of the transformer manufacturers was for an oil based on its sludge value and tested by a method far removed from service conditions, and very little attention was paid to its other properties. It is a well-known fact that the oxidation products of an oil at 150° C. are very different from those taken at 90° C. both in quantity and character. As a test for the eradication of unsuitable oils the author thinks that the Michie test has outgrown its original use.

Fifty per cent of the transformer oil used to-day is Grade *A* oil, typical examples of which give practically zero sludge values. For switchgear purposes where sludge is of small importance, highly refined oil is quite unnecessary. The less refined also the oil the cheaper it is, a point of importance when we consider the large bulk of oil used. Class *B* oils, which formerly were just obtainable with sludge values between 0·7 and 0·8, are to-day readily procurable at the low figure of 0·3 or even less. The author points out that in bringing the sludge value of oils down to these low limits the danger of the development of acidity is now as menacing as the old danger of high sludge values was. It may well be that in the light of modern experience, the highly refined *A* oils employed so widely to-day which have practically zero sludge value will be discarded and an oil of a moderate degree of refinement, but low developed acidity, will become the standard of transformer oil. Tests of *A* and *B* oils taken over a period of six months show that the rate of acidity increases for both oils, for the first three months is much the same but for the next three months the average acidity of the *A* oil increases much more rapidly than the *B* oil.

The greatest drawback of oil as a filling medium is its inflammability. In consequence of recent disastrous fires at Bradford and Kingston due to the oil in transformers and switchgear, and also the danger of fire from incendiary bombs, engineers have been recently studying closely the only non-inflammable liquids at present available, that is, synthetic chlorinated compounds. The commonest of these are the chlorinated diphenyls made in America and on the Continent but not yet manufactured in Great Britain. The degree of inflammability of pure chlorinated diphenyl, generally called in Great Britain 'aroclor', depends on the degree of chlorination. Experiments demonstrate not only the non-inflammability of 48 per cent chlorinated aroclor but also that, in addition, it has the valuable property of acting as a fire extinguisher.

In conclusion, the author discusses condenser oils, which are generally pure mineral hydrocarbon oils. Service conditions in this case are so severe that they cannot be used as delivered by the oil refiners, which can safely be done with transformers.

ROAD SURFACE TEXTURE PRINTS

THAT surface texture is an important factor in determining the resistance of a road to skidding has long been recognized, and at the Road Research Station one of the studies which has received attention has been the development of a satisfactory method of recording this quality. The latest device is an adaptation of the method of offset printing, and it is also the simplest and the most revealing in that it readily lends itself to a study of the changes which occur during the life of the road carpet and of its progress towards failure. A few square inches of the road under examination are cleaned of dust and then carefully inked over either by an ordinary half-tone black printing ink diluted with paraffin or by a water letterpress ink. A clean rubber roller, of specified hardness, is then run over the inked area and the impression taken by the roller is transferred to a sheet of white paper.

The prints which are obtained in this way are remarkable for the wealth of detail which they exhibit, even the finest particles on the surface, about a thousandth of an inch in diameter, being recorded. A Bulletin—Road Research Bulletin No. 3 ("A Printing Method of Recording Road Surface Texture". H.M. Stationery Office. 9*d*.)—just issued by the Department of Scientific and Industrial Research and the Ministry of Transport; gives a description of the process and of the apparatus which, it may be mentioned, packs into a suit-case. It exhibits a number of reproductions of prints taken by the process and these show the stones in the road surface appearing as in relief, the shading of the ink giving a stereoscopic effect. The interpretation of the prints requires experience, and though a surface likely to be slippery is easily recognizable, the assessment of the relative slipperiness of various carpets from their texture prints is more difficult. A series of these prints exhibits the changing nature of a given road surface; the prints are very convenient both for comparison and for storage.

PLANKTON OF THE JAVA SEA*

AN interesting preliminary investigation into the plankton of the Java Sea by Dr. H. C. Delsman shows that the coastal waters contain much plant and animal life and that towards the central part larger animals abound. The two monsoons, the east monsoon about September and the west monsoon about February, have an important influence on the currents.

Two special cruises were made across the Java Sea, from Java to Borneo and from Borneo to Java, when a number of stations were made. The first cruise was in April at the end of the wet, west monsoon, the second in October at the end of the dry, east monsoon. Vertical hauls were also made from near the surface to near the bottom. A comparison of the catches shows that the volume of plankton is higher in October, even if it is taken into account that at this time the larger organisms predominated, such as salps, siphonophores and mysid and amphipod crustaceans. The diatom plankton was generally found along the coasts, whereas the zooplankton was greater farther out and in the middle of the Java Sea, where diatoms were practically absent but where, sometimes, there were masses of Trichodesmium. The coastal plankton is generally of a finer composition, and besides diatoms contains numbers of the smaller copepods. Copepods, both small and large, abound and are the main food of the plankton-eating fishes.

The largest and commonest copepod is *Undinula vulgaris*, reaching in the female 3 mm. in length. This species is absent near the coast at both seasons and is found at a maximum away from the coast but is not present in the middle of the Java Sea. In April it appears in greater numbers than in October. Fishes sometimes have their stomachs full of Undinula, which in value as fish food may be compared with *Calanus finmarchicus* in other seas. *Labidocera acuta*, another large copepod, apparently occurs under more oceanic conditions, occasionally replacing Undinula. The presence of the larger species of copepods at a certain distance from the coast is of much importance in connexion with the fisheries, and further studies in this direction should be of great value. This part of the sea is already a favourite place for the mayang fishers to put out their nets for carangids and clupeoids, presumably where their copepod food is most abundant.

It is found also that the structure of the gill rakers of the plankton-eating fishes, their shape and the nature of the eyes are different in the different regions. Those clupeoids which feed in the coastal waters on the fine plankton have finer and more numerous gill rakers; those feeding a certain distance from the coast, where the plankton is much coarser and probably swallowed more discriminately, have much coarser gill rakes, a more slender body and larger eyes, thus being more capable of darting after their prey. The higher the number of gill rakes the greater their length and the smaller the diameter of the eye.

It is to be hoped that these preliminary plankton studies will lead to others on a larger scale.

* "Preliminary Plankton Investigations in the Java Sea". By Dr. H. C. Delsman. (*Treubia, bijdragen over Zoologie, Hydrobiologie en Oceanographie van den oost-indischen Archipel.* Deel 17. Aflevering 2. July 1939.)

SEVENTY YEARS AGO

NATURE, vol. 1, January 6, 1870

Plea for the Mathematician

PROF. J. J. SYLVESTER, F.R.S., in an article based on his presidential address at Exeter to the Mathematical and Physical Section of the British Association said: "Some people have been found to regard all mathematics, after the 47th proposition of Euclid, as a sort of morbid secretion, to be compared only with the pearl said to be generated in the diseased oyster, or, as I have heard it described, 'une excroissance maladive de l'esprit humain'. Others find its justification, its 'raison d'être', in its being either the torch-bearer leading the way, or the handmaiden holding up the train of Physical Science. . . . What is it to us, they say, if the three angles of a triangle are equal to two right angles, or if every even number is, or may be, the sum of two primes, or if every equation of an odd degree must have a real root? How dull, stale, flat and unprofitable are such and such like announcements! . . . But this is like judging of architecture from being shown some of the bricks and mortar, or even a quarried stone of a public building—or of a painting from the colours mixed on the palette, or of music by listening to the thin and screechy sounds produced by a bow passed haphazard over the strings of a violin."

Force of the Human Heart

IN an article on "The Labouring Force of the Human Heart", the Rev. Prof. Haughton, F.R.S., states that "its energy equals one-third of the total daily force of all the muscles of a strong man; it exceeds by one-third the labour of the muscles in a boat-race, estimated by equal weights of muscle, and it is twenty times the force of the muscles used in climbing, and eight times the force of the most powerful engine invented as yet by the art of man.

"No reflecting mind can avoid recognising in its perfection, and regarding with reverential awe, the Divine skill that has constructed it."

A SUCCESSFUL treatment for snake bite is recorded from the Rio Grande. Two horses were bitten by the same rattlesnake. A few hours afterwards the submaxillary, parotid, and all glands situated about the head and neck were greatly enlarged; from the nostrils and gums, a clear mucous discharge ran down; the eyes were glairy, with the pupils greatly dilated, and the coat was rough and staring. To each animal Dr. Bell gave half-a-pint of whisky, with a little water, and half an ounce of ammonia, while the wounds were fomented with a strong infusion of tobacco, and afterwards poulticed with chopped tobacco leaves. Both horses recovered.

"In furtherance of natural science work at Eton, an excellent telescope has been recently given to the school by the energy and liberality of some of the masters." Mr. H. G. Madan describes the instrument, a refractor of 5·9 in. clear aperture and 88 in. focus, made and erected by Messrs. Cooke and Sons, of York; it was equipped with a battery of eyepieces, of powers ranging from 30 to 400, and with a bifilar micrometer.

THE trigonometrical survey of England and Wales, on the scale of one inch to a mile, has been completed during the past week. It was commenced in the year 1791.

APPOINTMENTS VACANT

APPLICATIONS are invited for the following appointments on or before the dates mentioned:

LECTURER in the Electrical Engineering Department—S. C. Laws, Northampton Polytechnic, St. John Street, E.C.1 (January 8).

A DIRECTOR OF STUDIES for British Institute, Rome—The British Council, 3 Hanover Street, W.1 (quoting 'Italy') (January 13).

CIVILIAN SURVEYORS OF WORKS for the Military Engineer Services, India—The Military Department, India Office, S.W.1 (marked 'Surveyors Recruitment') (January 15).

ASSISTANT HEADMASTER (later to become Headmaster) for the Mackay School, Valparaiso, Chile—The British Council, 3 Hanover Street, W.1 (quoting 'Chile') (January 20).

TEMPORARY FORECASTERS, Grade II (Male) in the Meteorological Office—The Under-Secretary of State, S.2.B (Met.), Department Q.A., Air Ministry, Adastral House, Kingsway, W.C.2.

REPORTS AND OTHER PUBLICATIONS

(not included in the monthly Books Supplement)

Great Britain and Ireland

Amgueddfa Genedlaethol Cymru: National Museum of Wales. Thirty-second Annual Report, 1938–39. Pp. 53. (Cardiff: National Museum of Wales.) [1312

North of Scotland College of Agriculture. Report on the Work of the North of Scotland College for the Year 1938–39. Pp. 32. (Aberdeen: North of Scotland College of Agriculture.) [1412

British Empire Cancer Campaign. Sixteenth Annual Report of the Grand Council. Edited by J. P. Lockhart-Mummery. Pp. x+370. (London: British Empire Cancer Campaign.) [1512

Memoirs of the Cotton Research Station, Trinidad. Series B: Physiology, No. 12: Further Studies on Transport in the Cotton Plant. vii. Simultaneous Changes in the Production and Distribution of Dry Matter under varying Potassium Supply. By E. Phillis and T. G. Mason. Pp. 889–900. (London: Empire Cotton Growing Corporation.) 2s. 6d. [1812

Ministry of Health. The Control of Puerperal Sepsis. (Memo. 226, Med.) Pp. 10. (London: H.M. Stationery Office.) 2d. net. [1912

London School of Hygiene and Tropical Medicine (University of London) incorporating the Ross Institute. Report on the Work of the School for the Year 1938–39. Pp. xviii+98. (London: London School of Hygiene and Tropical Medicine.) [2112

Colonial Office. Higher Education in Malaya: Report of the Commission appointed by the Secretary of State for the Colonies, June 1939. (Colonial No. 173.) Pp. vii+151. (London: H.M. Stationery Office.) 2s. 6d. net. [2712

Other Countries

The Cooper Union for the Advancement of Science and Art. Eightieth Annual Report, for the Year ending June 30, 1939. Pp. 122. (New York: Cooper Union for the Advancement of Science and Art.) [712

Nigeria. Annual Report on the Forest Administration of Nigeria for the Year 1938. Pp. 14. (Lagos: Government Printer; London: Crown Agents for the Colonies.) 1s. 6d. [1112

Norges Svalbard- og Ishavs-undersøkelser. Meddelelse Nr. 42: Crossing West Spitsbergen from South to North. By Stanislaw Siedlecki. Pp. 14. Meddelelse Nr. 43: Some Pelecypods from Franz Josef Land, Victoriaøya and Hopen collected on the Norwegian Scientific Expedition 1930. By T. Soot-Ryen. Pp. 22+1 plate. Meddelelse Nr. 44: A Small Contribution to the Lichen Flora of the Eastern Svalbard Islands—Lichens collected by Olaf Hanssen in 1930. By B. Lynge. Pp. 12. Meddelelse Nr. 45: Recent Norwegian Expeditions to South-East Greenland. By Gunnar Horn. Pp. 10. Meddelelse Nr. 46: The Settlements and Huts of Svalbard. By Anders K. Orvin. Pp. 14. Skrifter om Svalbard og Ishavet, Nr. 76: Lichens from Jan Mayen collected on Norwegian Expeditions in 1929 and 1930. By B. Lynge. Pp. 56+2 plates. 4.50 kr. Skrifter om Svalbard og Ishavet, Nr. 77: Das Festungsprofil auf Spitzbergen, 5: Stratigraphie und Invertebraten-fauna der älteren Eotrias. Von Hans Frebold. Pp. 58+3 plates. 5.00 kr. (Oslo: Norges Svalbard- og Ishavs-undersøkelser.) [1112

Memoirs of the India Meteorological Department. Vol. 27, Part 2: Discussion of Results of Sounding Balloon Ascents at Madras in the Months of June to November during 1932–1935. By N. K. Sur and K. P. Ramakrishnan. Pp. 29–44+3 plates. (Delhi: Manager of Publications.) 14 annas; 1s. 3d. [1212

Publications of the Observatory of the University of Michigan. Vol. 8, No. 1: A Study of the Spectrum of VV Cephei. By Victor Goedicke. Pp. 36+4 plates. (Ann Arbor, Mich.: University of Michigan.) [1312

Proceedings of the United States National Museum. Vol. 87, No. 3073: Observations on the Birds of Northern Venezuela. By Alexander Wetmore. Pp. 173–260. (Washington, D.C.: Government Printing Office.) [1312

U.S. Department of Agriculture. Leaflet No. 189: Psocids, Annoying House Pests. By E. A. Back. Pp. 4. (Washington, D.C.: Government Printing Office.) 5 cents. [1312

Bulletin of the American Museum of Natural History. Vol. 76, Article 7: A Revision of the Typical Crab-Spiders (*Misumeninae*) of America North of Mexico. By W. J. Gertsch. Pp. 277–442. (New York: American Museum of Natural History.) [1312

Annales Bryologici: a Year-Book devoted to the Study of Mosses and Hepatics. Edited by Fr. Verdoorn. Vol. 12 (1939). Pp. vi+164. (Leiden: Chronica Botanica Co.; London: William Dawson and Sons, Ltd.) 6 guilders. [1312

U.S. Department of the Interior: Office of Education. Bulletin, 1939, No. 3: High Educational Institutions in the Scheme of State Government. By John H. McNeely. Pp. v+108. 15 cents. Bulletin, 1939, No. 6: Education in Yugoslavia. By Severin K. Turosienski. Pp. vii+146. 25 cents. (Washington, D.C.: Government Printing Office.) [1812

Advisory Committee on Education. Staff Study No. 3: State Personnel Administration, with Special Reference to Departments of Education. By Katherine A. Frederic. Pp. xiv+270. (Washington, D.C.: Government Printing Office.) 35 cents. [1812

Canada: Department of Mines and Resources: Mines and Geology Branch, Bureau of Mines. The Mining Laws of Canada: a Digest of Dominion and Provincial Laws affecting Mining. Compiled by Arthur Buisson. (No. 795.) Revised edition. Pp. vii+110. (Ottawa: King's Printer.) 25 cents. [1812

Colony of Mauritius: Department of Agriculture. Ninth Annual Report of the Sugarcane Research Station for the Year 1938. Pp. 66. 85 cents. Sugarcane Research Station, Bulletin No. 16: A Botanical and Agricultural Description of some Sugarcane Varieties raised by the Sugarcane Research Station, Mauritius. By Dr. H. Evans and G. C. Stevenson. Pp. v+10+5 plates. 45 cents. (Port Louis: Government Printer.) [1812

Meddelelser om Grønland udgivne af Kommissionen for Videnskabelige Undersøgelser i Grønland. Bd. 78, Nr. 5: The Godthaab Expedition 1938—A Theoretical Treatment of the Hydrographical Observation Material. By Alf B. Kilerich. Pp. 150+14 plates. 8.50 kr. Bd. 105, Nr. 4: The Scoresby Sound Committee's Second East Greenland Expedition in 1932 to King Christian IX's Land—The British East Greenland Expedition 1935–36. Geological Investigations in East Greenland, Part 3: The Petrology of the Skærgaard Intrusion, Kangerdlugssuaq, East Greenland. By L. R. Wager and W. A. Deer. Pp. 352+27 plates. 20.00 kr. Bd. 119, Nr. 10: A Revised Index of the Insects of Grønland, containing a Supplement to the Insect List in Kai L. Henriksen and Will. Lundbeck: Grønlands Landarthropoder. (Medd. om Grønl., Bd. 22, 1918.) By Kai L. Henriksen. Pp. 112. 5.00 kr. Bd. 120: Poul og Niels Egede: Continuation af Hans Egedes Relationer fra Grønland samt Niels Egede: Beskrivelse over Grønland. Ved H. Ostermann. Pp. xl+380. 18.00 kr. Bd. 125, Nr. 1: An Annotated List of the Fishes collected on the Several Expeditions to Greenland, the Fox Basin Region, and the Coast of Labrador, by Capt. E. A. Bartlett, from 1925 to 1935. By Samuel F. Hildebrand. Pp. 12. 0.50 kr. Bd. 125, Nr. 2: The Greenland Variety of *Theromyzon parjasevi* (Livanow). By S. A. Boisen Bennike. Pp. 8. 0.35 kr. Bd. 125, Nr. 3: Contributions to the Glaciology of North-West Greenland. By J. W. Wright. Pp. 44+6 plates. 2.50 kr. Bd. 125, Nr. 4: I. Studies on the Embryology and Cytology of Saxifraga. By L. Harmsen. Pp. 16. 0.75 kr. Bd. 125, Nr. 5: Toxin in the Flesh of the Greenland Shark. (Communication from Upernavik and the University Zoophysical Laboratory at Copenhagen.) By Ove Bøje. Pp. 16. 0.75 kr. (København: C. A. Reitzels Forlag.) [1812

League of Nations: Advisory Committee on Social Questions. Enquiry into Measures of Rehabilitation of Prostitutes (Part 3 and Part 4): Methods of Rehabilitation of Adult Prostitutes, Conclusions and Recommendations. (Official No.: C. 83. M. 43. 1939. IV.) Pp. 157. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 3s. 6d. [1812

Tanganyika Territory: Department of Agriculture. Annual Report 1938. Pp. 62. 3s. Pamphlet No. 25: Sisal Experimental Station Report for the Year 1938. Pp. 24. 50 cents; 6d. (Dar es Salaam: Government Printer.) [1912

Ministry of Public Works, Egypt. Physical Department Paper No. 39: Report on the Measurement of the Quantity of Dust in the Atmosphere of Cotton Ginneries. By H. E. Hurst and P. A. Curry. Pp. 14. (Cairo: Government Press.) P.T. 5; 1s. [2012

Indian Forest Records (New Series). Entomology, Vol. 6, No. 1: New Indian Cerambycidæ. By J. C. M. Gardner. Pp. 14. (Delhi: Manager of Publications.) 6 annas; 7d. [2012

Annual Report of the Agricultural Meteorology Section, India Meteorological Department, for the Year 1937–38. Pp. 50+6 plates. (Delhi: Manager of Publications.) [2012

India Meteorological Department. Scientific Notes, Vol. 8, No. 83: On the Forecasting of Rain over South Bengal during the Nor'wester Season, mid-March to mid-May. By A. K. Roy. Pp. 8. (Delhi: Manager of Publications.) 5 annas; 6d. [2012

Observatoire de Zi-Ka-Wei. Annales de l'Observatoire astronomique de Zô-Sé (Chine). Tome 21, Fasc. 2: Tables des petites planètes 149, 270, 317, 345. Par le P. E. de la Villemarqué. Pp. 46. Tome 21, Fasc. 3: Positions photographiques d'Eros (1930–1931) et (O—C) conclus. Par le P. E. de la Villemarqué. Pp. 20. Tome 22, Fasc. 1: Le pendule élastique inversé, son application au nivellement des instruments astronomiques; queiques essais. Par le P. M. Burgaud. Pp. ii+28+7 plates. Notes de Météorologie physique, Fasc. 9: Étude de la vapeur d'eau, de l'oxygène et des poussières contenues dans l'atmosphère à l'Observatoire de Zô-Sé. Par le R. P. Pierre Lejay. Pp. ii+67. (Zi-Ka-Wei: Observatoire de Zi-Ka-Wei.) [2012

U.S. Department of the Interior: Office of Education. Bulletin 1939, No. 10: The Graduate School in American Democracy. By Isaiah Bowman. Pp. ix+70. (Washington, D.C.: Government Printing Office.) 15 cents. [2112

League of Nations. Report on the Work of the League (continuation) July–mid-November 1939 (Official No.: A. 6 (a). 1939.) Pp. 62. (Geneva: League of Nations; London: George Allen and Unwin, Ltd.) 1s. 6d. [2112

Anthropological Records. Vol. 1, No. 7: Culture Element Distributions, 11: Tribes Surveyed. By A. L. Kroeber. Pp. 435–440. (Berkeley, Calif.: University of California Press; London: Cambridge University Press.) 25 cents; 1s. 6d. net. [2712